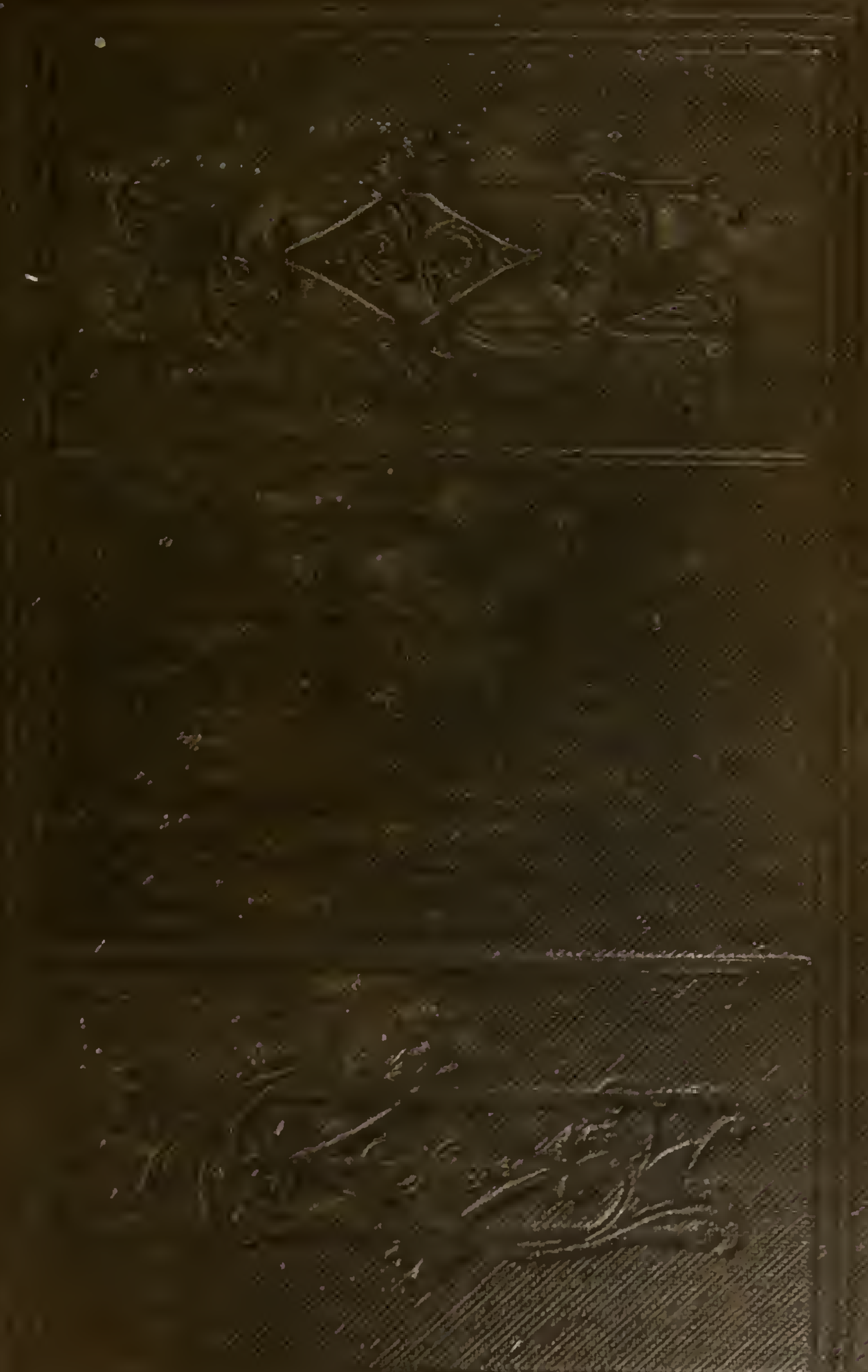

THE PRACTICE

OF

SURGERY

A MANUAL

FOR THE

PRACTICE

OF

SURGERY

BY

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WITH SEVEN HUNDRED AND FORTY-SEVEN ILLUSTRATIONS

Fourth Edition (Twelfth Thousand)

VOL. II

LONDON
J. & A. CHURCHILL
11, NEW BURLINGTON STREET
1884

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THE
PRACTICE OF SURGERY.

SURGERY OF THE RESPIRATORY SYSTEM.

CHAPTER XVII.

SURGICAL AFFECTIONS OF THE NOSE.

Congenital and other Defects of Nose.

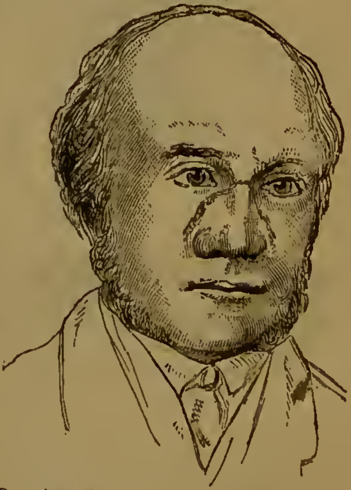
The nose may be congenitally absent or fissured, as illustrated in Fig. 47, p. 212, vol. i. The nostrils may likewise be congenitally or otherwise occluded from cicatricial contraction after ulceration or smallpox, and for these defects surgery may be successfully called into requisition either to establish an orifice or to prevent its contraction.

Wounds.

Wounds.

Incised and lacerated wounds of the nose generally progress well on account of the freedom of its vascular supply. The edges of any wound should consequently be brought carefully together and fixed with sutures, even if the part be nearly or wholly separated from the body. For this purpose very fine silk ought to be used, and great care exercised in the accurate adjustment of the parts—a suture being passed through the cartilages when they have been divided. In the case illustrated in Fig. 298, where the nose was nearly cut off, the edges of the wound were adjusted and a good recovery followed.

FIG. 298.



Drawing illustrating the repair after an incised wound of the nose.

Fracture of the Nose.

Fracture of nasal bones.

This accident is not uncommon, and may be simple or compound. It may likewise be followed by little or great deformity, the amount depending much upon the care and skill with which the broken bones have been readjusted. When displacement has taken place, the Surgeon must restore the misplaced bones by external manipulation, aided by pressure applied from within the nasal cavity by means of the blades of the ordinary dressing forceps, or a steel probe. When the parts have been restored to their natural position, or as nearly so as is possible, care must be observed that no external pressure is employed by which they can be displaced. Plugging of the nostrils is useless. When little or no displacement exists, nothing better is required than the application of cold-water dressing, or perhaps ice, for the first few hours, as these bones rapidly re-unite.

Dr. L. D. Mason, of Brooklyn, U. S., has suggested the use of a wire suture passed transversely through the nose to keep depressed fractures in position ('Annals of Anat. and Surg. Society,' 1880.)

Complicated with fracture of the skull.

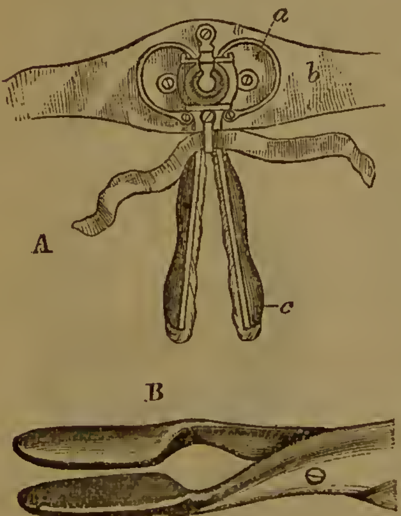
Fracture of frontal sinus.

When the force has been severe and direct upon the nose, fracture of the skull may complicate the case—fracture either of the ethmoid bone forming the floor of the base of the skull, as has been illustrated in the chapter on injuries of the skull (Fig. 67), or fracture of the frontal bone. This latter form may be generally recognised by swelling and crepitation of emphysema about the forehead, or the crepitus of the fracture with displacement, &c. Cases of fracture of the frontal sinus require no special treatment, and generally do well.

Dislocation of cartilages of nose.

In children, the cartilage of the nose may be displaced from the nasal bones in consequence of an injury, and unless replaced, permanent deformity and obstruction will ensue. The Surgeon consequently, when this accident takes place, should do his best to restore the misplaced parts and to keep them in apposition, although some difficulty is often experienced in its accomplishment.

Fig. 298*a*.



Forceps and nose truss for treatment of deformed nose.

Displacement of septum.

Adams' operation.

With the view of preventing or correcting deformity Mr. W. Adams has suggested, that the broken or bent septum should be straightened by strong plate-bladed forceps (Fig. 298*a* B) and the broken nasal bones raised, these parts subsequently being maintained in position by an ivory clamp, and the side of the nose pressed into place by a nose truss (Fig. 298*a* A) connected with a forehead plate (*a*) and band (*b*). The plates (*c*) are shaped according to the outline of the nose, and are made to diverge by rotating a central controlling screw, the pressure of the plates being regulated by two circular springs. The ivory clamp must be worn day and night for three or four days after the deformity has been corrected, and the nose truss for some months during the day.

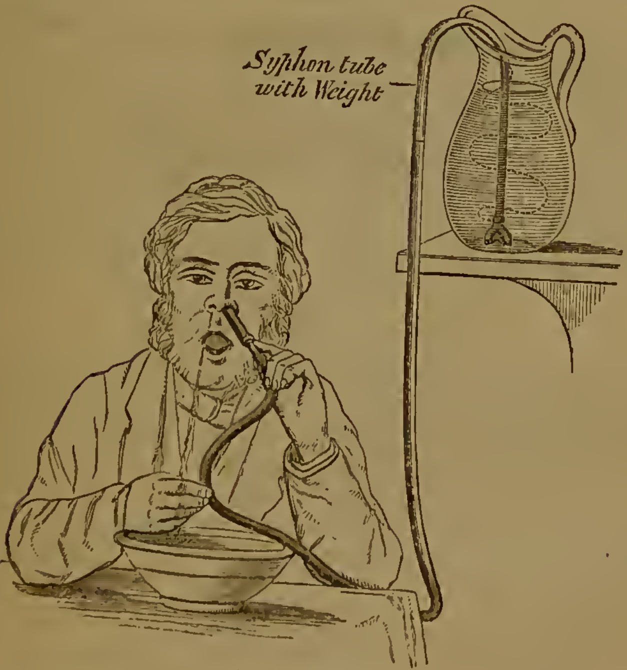
Epistaxis.

Bleeding from the nose is an occurrence of considerable frequency, and when not too free or lasting, rarely requires surgical interference. It may be the result of an injury—*traumatic;* or associated with some cancerous affection or fibrous growth from the base of the skull or other local cause; or, it may be the direct consequence of some fulness of the vessels of the head or heart disease. It is found also as a kind of *passive* exudation in anæmic and cachectic subjects; after purpura or from hepatic disease, and also as supplementary to the catamenia. Epistaxis.

TREATMENT.—With a view to successful treatment the cause of the bleeding must be ascertained. When traumatic, it usually stops without aid. When due to plethora of the vessels from any cause, it is often salutary, and should be checked only when too copious or lasting. When of a passive nature it is serious, since anæmic feeble subjects cannot bear loss of blood, and the loss tends to aggravate its cause. In one case, therefore, saline purgatives may be of value; in another, iron in full doses, or gallic acid in gr. v or gr. x doses. As to its treatment no definite rules can be laid down, it being a common accompaniment of so many different conditions, local and general. Treatment. General.

When, however, life is threatened by its severity, real or comparative, the Surgeon is bound to interfere. The head should be kept raised, and cold applied, by means of ice, to the nose and frontal sinuses. Local.

FIG. 299.



Nasal douche.

A steady stream of some cool saline liquid (a teaspoonful of carbonate of

Douche.

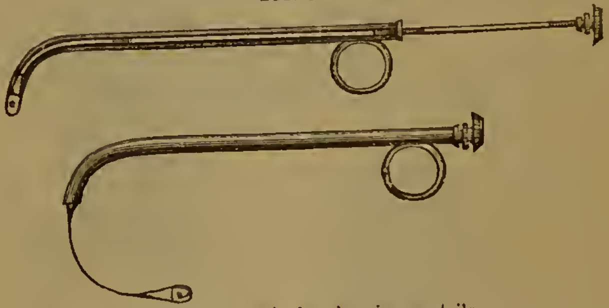
soda and common salt to a pint of water being as good as any) passed through the nostril is a very effectual mode of treatment. For this purpose, the double-action india-rubber enema apparatus with a nose-piece to introduce into the nostril may be employed; or Dr. Rasch's vaginal syphon douche, applied as in Fig. 299, the patient breathing at the time through the mouth, which should be kept wide open; Professor Weber, of Halle, having discovered, years ago, that while the patient is breathing through the mouth the soft palate completely closes the posterior nares, and does not permit any fluid to pass into the pharynx. The popular methods of placing the patient in the erect posture, and raising both arms above the head, may likewise be tried, as they are unquestionably good. If these measures fail the nostril or nostrils must be plugged.

Plugging.

Mode of plugging.

Plugging Nose.—To do this effectually some skill is necessary; to do it otherwise is useless, if not injurious. To plug from the anterior nares alone is to trifle with the hæmorrhage, and merely to mask the escape of blood as well as to direct it down the pharynx, under which circumstances severe loss of blood may take place without knowledge. To perform the operation of plugging effectually, a plug of lint, cotton wool, a sponge tent, or compressed sponge, an inch and a quarter long and an inch wide, should be prepared and fastened in the middle by a double piece of strong silk or whipcord, an end about six inches long being left on one side, and two ends or a loop, a foot long, on the other. With Bellocq's canula (Fig. 300), a long-eyed probe, or an elastic catheter, a loop of the same material should be passed into the nose along its floor through the posterior nares into the pharynx, and caught either by the fingers or forceps. This end should then be fastened to the long ends on the plug and the instrument withdrawn through the nostril. The plug having been well oiled, is then to be drawn into the mouth by applying traction upon the ligatures protruding from the nostril, tilted with the finger behind and above the soft palate, and carefully adjusted or wedged into the posterior nares; by which means the escape of blood into the pharynx will be prevented. The two cords hanging from the anterior nares are then to be separated, and the nasal cavity filled with compressed sponge, lint, or cotton wool, which should be introduced between them, the whole mass being made secure by tying the two cords across the plug that has been introduced in front, and fastening them in a bow to allow of un-

Fig. 300.



Bellocq's canula for plugging nostrils.

fastening. When any styptic is deemed necessary, the sponge, cotton wool, or lint introduced into the anterior nares may be saturated with the solution of the perchloride of iron, tannin, matico, or a concentrated solution of alum. By this means the possibility of any escape of blood from either opening of the nose can be effectually prevented, and the most dangerous epistaxis absolutely controlled. To remove the apparatus, the knot at the anterior nares should be undone and the anterior plug taken out, the posterior being readily drawn from its position by means of the short end attached to it in the pharynx, which may be left hanging down the patient's throat. The plug should not be left in more than three or four days, but may be reintroduced if necessary, the Surgeon, in doing so, taking care to preserve *in sitû* the two pieces of cord that have been passed along the floor of the nose. The inflating nasal india-rubber plug of Mr. H. C. Howard is likewise good for plugging purposes. It can readily be inflated when in position, and as readily removed ('Brit. Med. Journ.,' 1881, p. 896).

Lipoma or, more correctly, Hypertrophy,

Lipoma.

of the nose is a readily recognisable affection, and is a disease of the skin and subcutaneous tissue (not of the cartilages), in which the follicles may or may not participate. It is confined to the apex and alæ of the organ. The enlargement is sometimes general, at others, the swellings are pendulous, lobulated, and loose. The capillaries of the part are sometimes congested, giving the growth a purplish hue. As a rule, it is painless, and causes only mechanical annoyance. It interferes at times with vision and the functions of the nose, and, moreover, wounds vanity.

Treatment.

Nothing but the removal of the growth can be suggested, which can be done without danger, and with no great difficulty. The redundant mass is to be dissected off, care being observed not to encroach upon the nostril. This is best done by introducing the little finger or a spatula into the nostril, and shaving the redundant mass off the cartilage with a scalpel. Any bleeding that may take place can usually be checked by cold, styptics, or torsion; the wound that is left should be allowed to granulate. The Surgeon should be careful not to take away too much or to go too deep, but to leave some covering to the cartilages. The disease rarely returns. The late Mr. Hey, of Leeds, was the first to perform the operation described.

Lupus.

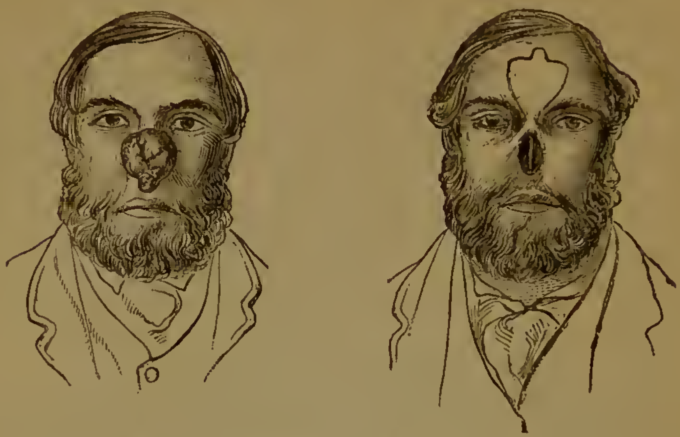
Lupus exedens.

This affection is more common on the nose than in any other part of the body, and is often very destructive; so much so, indeed, as to destroy the whole organ. It is, however, more amenable to treatment than is usually supposed. Too often it is described as a strumous, and therefore constitutional affection, and regarded as incurable. It would be well, however, if Surgeons would practically regard it more as a local disease. The best local treatment is its entire destruction, which may be effected by scraping away the diseased tissue with a blunt knife or the handle of a scalpel, followed by the application of carbolic acid on lint to the exposed surface; by excision, or the free application of the galvano- or thermo-cautery. One of the worst cases of lupus of the nose that I have seen was that illustrated in Fig. 301. It had existed for years, and was cured in a month, after one free application of the

Treatment.

galvanic cautery, every ulcerating tubercle of unhealthy tissue being freely destroyed.

Fig. 301. Fig. 302.



Lupus of nose with the outline of a flap for a new nose. From life.

Tonic treatment also must not be neglected; while, as a palliative application, cod-liver oil is very beneficial. Arsenic is also highly commended by Messrs. Hunt and others, and Donovan's solution when there is any syphilitic taint.

Lupus non-exedens. The lupus non-exedens may be regarded as an early stage of the lupus exedens; both have a papular origin and become tubercular, the tubercles ulcerating at a later stage.

Epithelial Cancer and Rodent Cancer

Epithelial cancer. may attack the nose, the former usually appearing at first as a warty growth, which subsequently ulcerates; the latter as a firm, uncoloured, solitary nodule, which excoriates, then scales and bleeds, and finally ulcerates, deepening and extending the scabbed excoriation. In the epithelial cancer, the margin of the sole is more irregular and thicker than in the rodent ulcer, although until the lymph-glands are affected it is somewhat difficult to distinguish between the two. Indeed, the epithelial cancer may be for long undistinguishable from the rodent cancer. The treatment of both, however, consists in the total destruction of the ulcerating surface and its edges, by cautery, escharotics, or the knife. I have treated many of the epithelial forms by means of the galvanic cautery with gratifying success. The disease, like other cancers, is, however, liable to return.

Rhinoscopy.

Rhinoscopy. The examination of the nasal cavity may be made through the nostrils by means of a speculum, and for the purpose reflected sunlight is the best, or, this failing, reflected artificial light must be employed. The posterior nares can be examined by means of a mirror introduced behind the soft palate, after the same fashion as in laryngoscopy, the parts being reflected from the mirror, which is illuminated by sun or artificial light. The best aid may also be obtained by means of the finger introduced through the mouth behind the soft palate. Czermak speaks highly of the value of a small mirror introduced through the nostril, which should be well illuminated. I have, however, found all the help I wanted in digital examination and posterior rhinoscopy, taking care to draw forward with great gentleness the soft palate by means of forceps. This method of examination is, however, at times difficult.

Diseases of the Nostrils causing Obstruction.

Nares obstructed by disease.

These are very common, and for such the Surgeon is often consulted. In the infant such a condition may be the result of congenital syphilis, which will be indicated by the history of the case and the concomitant symptoms. The *snuffles* in infancy are very characteristic, and should always direct the practitioner to look out for some syphilitic affection. In isolated cases such a symptom may be the only one of hereditary syphilis, and, by proper treatment, it may be cured without any other complication making its appearance; although, as a rule, if looked for, some cutaneous affection will be observed. A grain of grey powder with three or four grains of dried soda, twice a day, generally proving quite sufficient to cure the disease. When the mother is suckling, the child may be physicked through the mother, taking five or more grains of the iodide of potassium with quinine, half an hour before suckling, three times a day.

Warty growths.

Warty growths are sometimes met with at the orifice of the nostril, causing obstruction. They are to be cured by the removal of the growths.

Foreign Bodies in the Nasal Cavity.

Foreign bodies in nares.

When a child suffers from any obstruction to the nasal cavity, and particularly when such is one-sided, the presence of a foreign body should be suspected, and the practitioner in such instances should never allow himself to be misled by the absence of a history of its introduction, since instances are not uncommon where some foreign body has been left in the nasal canal for months. A child, four years of age, came under my care, who had suffered from all the miseries of an obstructed nasal passage for eight months, from the presence of a plum-stone. Many remedies had been tried but without effect, the foreign body being unsuspected. Its removal was rapidly followed by convalescence. Ulcerations of the mucous membrane from the inflammation excited by the foreign body may tempt the Surgeon to overlook the nature of the case. He should therefore remember that such a disease as ulceration of the nose in children, except at the immediate orifice, is by no means common, and that the probabilities of its being excited by a foreign body are very great. When only one nostril is affected the diagnosis is more sure.

Mode of removal.

The removal of these bodies when firmly impacted requires some care, and the administration of an anæsthetic cannot be too highly recommended, particularly when the child is young. A firm, hook-bent probe introduced down the floor of the nose may be passed with facility behind the foreign body; or, a noose of wire, twisted or not, inserted along the septum and half turned, will generally, after one or two attempts, hook out the offending body. In some cases a pair of forceps will suffice. Gingerbread and other soft materials may have to be scooped out and the nose well syringed. I have never known any good result from syringing this cavity when any solid body has become impacted, except for the sake of cleanliness. Mechanical means always succeed, and are the simplest, particularly when the child is under the influence of an anæsthetic. In older children and in adult life, obstruction to the nasal passage may be produced by many diseases. When the presence of a foreign body is the cause, a true history of the case will generally be given, and thus the Surgeon is more likely to arrive at a just conclusion as to the character of the disease.

Nasal Calculi or Rhinolithes.

Nasal calculi.

Such cases have been recorded; I have seen but one instance, and that proved to be due to the introduction of a foreign body. It occurred in the practice of Mr. B. Duke, of Clapham. On examination by Dr. Stevenson the calculus was found to consist of 75 per cent. of earthy carbonates and phosphates, and 25 per cent. of organic matter with cotton wool. They may be small, or so large as to obstruct the nostril. Obstruction and more or less pain are said to be the chief symptoms, and occasionally a copious discharge of mucus or pus. The calculus can be detected on examination, and, when found, it should be removed by douche, snare, or forceps. Cases are on record in which the concretion was crushed before removal.

Polypus Nasi.

Polypus nasi.

Gelatinous form.

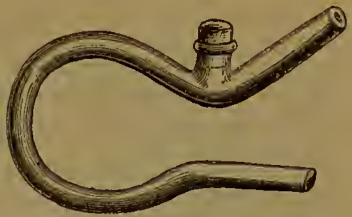
This is a common affection, and may be found in one or both nostrils of the old or young. It may be of a simple mucous or fibrous structure, or it may be of a malignant nature. The mucous are by far the more common forms, and are not difficult to recognise; they, as a rule, spring from the middle turbinated bone and from its posterior portion, though they may grow from other parts. I have only removed one from the septum. They are seldom recognised in an early condition, since they cause no pain and but little inconvenience. A slight excess of discharge is the earliest symptom, and this is generally regarded as being the result of "cold;" but when this secretion is examined it will be observed to be more serious than is found to exist in an ordinary coryza. In exceptional cases the serous flow may be very free. Sir J. Paget has recorded ('Clin. Soc. Trans.,' vol. xii) a case in which this symptom existed, and where after death fine polypoid growths were found in the antrum. The discharge continuing, may at last cause some anxiety to the patient, and, if the Surgeon be consulted, a careful examination with a speculum should be instituted, when a polypus, or rather a fringe of polypi, will often be observed on the margin of the middle turbinated bone. When the disease has been made out, removal of the growth is the only effectual treatment. Tonics and local astringents may for a time retard their growth, but rarely effect a cure. The use of tannin as a snuff has been very successful in my hands in causing the sloughing off of even the largest polypi ('Lancet,' Feb., 1867); but the remedy is uncertain; it is, however, always of value in destroying the smaller, and thus in checking the progress of the disease. Of late years I have employed a spray composed of equal parts of alcohol and a ten-grain solution of boracic acid to the ounce of water, the alcohol withering the small growths.

Treatment.

Snuff.

I have had several instruments made to apply the tannin, but the bent glass tube is as good as any. It is modified from one made by a patient for his own use, and answers well. The tannin is put into the small receptacle in the upper half, that end of the tube being inserted into the nostril, and the other into the mouth, and the patient then blows tannin into his nostril.

Fig. 303.



Abruption.

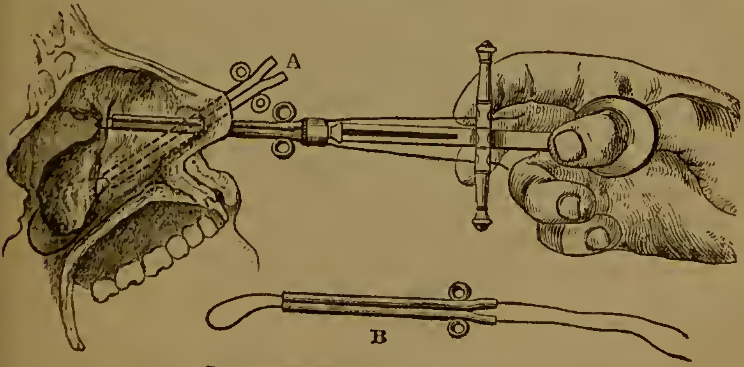
The removal of the softer kinds of polypi should always be by abruption. Some Surgeons employ a long pair of narow well-made forceps, which fix the pedicle, and then by a slight twist and some force, the removal of the growth is effected. When the polypus hangs far back, the introduction of the finger into the mouth and behind the fauces facilitates its removal. The best instrument known is the "noose," and that illustrated in Fig. 304 is the form I prefer. It is so constructed that a loop of wire introduced along the septum and half turned can be made to pass over the polypus and encircle its peduncle. The loop is then drawn home, the growth strangled at its neck, and abrupted. By these means the polypus is removed as a whole and bleeding is prevented; consequently, by the use of this instrument, the nose can generally be cleared at one operation. In some cases, I have cured the disease by cutting off with a long pair of scissors the turbinated bone from which these polypi grow. A few days after the removal of the polypi by the snare, tannin, as a snuff, or the alcohol and boracic acid lotion used as a spray may be employed.

Noose.

Rouge's operation.

In severe cases in which this treatment has been employed with but poor success, Rouge's operation, as suggested by him for the treatment of certain cases of ozæna in 1873, may be performed, the operation consisting in the elevation of the upper lip and soft parts of the nose from their osseous attachments by means of an incision made beneath the lip through the mucous membrane where it is reflected from the lip into the gums, the lip and nasal cartilages by these means being so freed from their attachments as to allow the Surgeon to lift them up as a whole towards the forehead, and thus reaching the nasal cavity for

Fig. 304.



Removal of nasal polypus by noose.

purposes of exploration or operation. To give more room, the septum nasi may require to be separated from its base. After the operation the parts readily fall into position, and should be kept there by strapping. No deformity or visible scar follows the operation.

The mucous form of polypus seems to be more common in men than in women, and is a disease of young adult life. I have known it, however, to appear in a man aged seventy-five.

Fibrous form.

The firmer and fibrous forms of polypi are by no means so common as the mucous, and seldom spring from the turbinated bones. They grow more frequently from the upper and posterior portion of the nasal cavity, from the top of the pharynx and the posterior nares, and have a periosteal origin. They do not make their appearance so early in life as the mucous, are far more serious in their nature, and more difficult to treat, on account of their position; and when removed, they rarely return. The best mode of treatment is to ligature them through the nose by means of a loop of whipcord or wire passed through the nostril into the pharynx, and slipped over the growth. When this operation cannot be performed the nostril may be laid open to give room for manipulation, or it may be necessary to remove the nasal process of the superior maxillary bone, or displace the body of, but not remove, the upper jaw itself, to reach the tumour. In 1865 I removed a large tumour of this kind, which completely obstructed the posterior nares of a boy, æt. 14, by the ligature introduced through the nostril ('Path. Trans.,' vol. xviii), and in 1868, I removed a second from a lad, æt. 18, in the same way. In 1872, in another case, I took away a portion of the upper jaw to get at a tumour of the spheno-maxillary fossa, which filled up the nostril from behind. In 1883 I removed by evulsion, from a man who was dying from bleeding, a large growth from behind the palate and posterior nares, but with a fatal result, the growth having sprung from the base of the skull, and invaded the cranium. Some of these polypi grow from the antrum, and press inwards. The Surgeon should bear this fact in mind in examining a case, as it may materially affect his treatment.

Treatment.

Examples.

Cancerous tumours.

Cancerous tumours of the nose are found in practice, although not frequently. They may attack the body of the organ, as seen in Fig. 305, or grow from within and press forwards or backwards, filling in the anterior or posterior nares, when they are difficult to diagnose. They are, perhaps, more common in the old than in the young, although two cases have passed under my care in patients under thirty. They are generally associated with bleeding, either from the nose or pharynx. When they grow from within, their removal when possible, is an expedient practice, if only to give relief, and this can be done much in the same way as in the other varieties of polypi.

Removal.

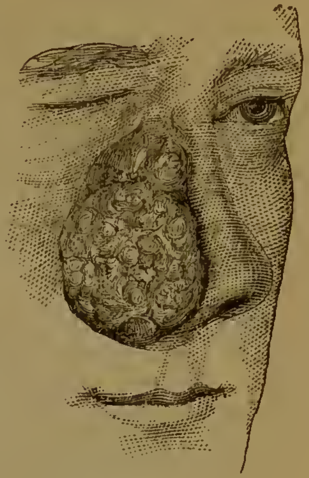
Conditions simulating polypus.

Conditions simulating Polypus.—The conditions of the nasal cavity which are not infrequently mistaken for polypus are numerous. Many such have passed under my notice, the patients applying for the removal of such a growth, when in reality no growth existed.

Bent septum.

Malformation of the septum nasi is one of the most common deformities of the nose. In it the septum projects either into the right or left nostril, causing more or less obstruction to respiration, and leading a superficial observer to believe in the presence of some new growth. This deformity may sometimes be the result of an injury; and, when so, there is generally some lateral twist of the nose itself. The knowledge of the existence of such a condition is quite sufficient to prevent any careful Surgeon falling into this error. For the relief of this deformity an attempt may be made by Adams's forceps to loosen the septum, and to fix it in a better position; or comfort may be given by admitting air through a perforation of the septum made by cutting forceps.

Fig. 305.



Cancer of nose.

A chronic inflammation and thickening of the mucous lining of the nose is another condition which may be, and frequently is, mistaken for polypus. In it the patient complains of difficulty in respiration, and feels that there is something in the nose which mechanically impedes that function. On examining the cavity, a smooth, projecting, and firm outgrowth will be observed on its outer wall, which may be regarded as a polypus, but which is really only the lower turbinated bone covered by a thickened œdematous or inflamed mucous membrane. In a case such as this, if a little care be taken in sifting its history, it will probably be found that an obstruction to the respiration will be the only symptom of importance; there will be no serous discharge, such as is so copious in cases of polypi, although there may be a discharge of tenacious mucus; yet this is not common, since the secreting function of the mucous membrane in these cases will generally be found diminished, and a great dryness present, accompanied by a loss of the sense of smell.

Treatment.

The best treatment in such examples is the constitutional, in the form of tonics, using that which appears to be more suited to the general wants of the patient's system. Some slight stimulating lotion, such as the sulphate or chloride of zinc, or nitrate of silver of the strength of two grains to the ounce, may at times be required, but constitutional means alone are generally sufficient. Removal of the turbinated bone for this affection has been advocated and performed by some Surgeons. I have adopted the practice in some obstinate cases with marked success.

It is worthy of observation that this disease is at times confined to the mucous membrane over the lower turbinated bone; and for reasons which I am unable to explain.

The septum may likewise be the seat of inflammation, either acute or chronic; and, as a result, great swelling of the soft parts covering it in will be present, giving rise to obstruction. When pus exists, an early opening is advantageous. In some cases, a perforating ulcer may appear; in others, exfoliation of the cartilage. I have removed from a boy, a *cartilaginous outgrowth* from the septum which obstructed the nostril, which had a base the size of a sixpence. Tumour.

Ozæna.

Ozæna.

This term is applied to a large and important class of cases where an offensive discharge, or rather smell, is the common symptom, which is due to many different morbid conditions.

Source of fetor.

It has been said that this offensive smell is the result of some morbid secretion of the part, but my own experience has not furnished me with any information tending to confirm such an idea, and, I believe, that the fetor is generally, if not always, the result of the decomposition of retained mucus. At one time it may be associated with inflammation or ulceration of the mucous membrane; and at another, with some diseased bone the result of syphilis or otherwise. Under all circumstances, the disease is an insidious one, and many months have usually elapsed before it comes under the notice of the Surgeon or medical adviser.

Symptoms.

The patient at first believes the symptoms to depend upon an ordinary catarrh; the discharge from the nose being thick, but not offensive, and the sense of smell more or less impaired. If these symptoms continue, the health of the sufferer often declines, and the physician is consulted on account of want of power, the local symptoms assuming a secondary importance. If the nose be examined at this time, as it should be, with a speculum, to obtain a good view of the whole, the only visible morbid condition may be, either intense congestion of the mucous membrane, which will not be much, if at all thickened, or some ulcer. This congestion of the mucous membrane being associated with excess of secretion, and the ulcer with a variable discharge; when dead bone exists a probe will detect it.

Local examination.

Treatment.
General.

Treatment.—In the majority of cases the only correct and satisfactory treatment is the constitutional. When the general condition of the body is improved the local disease will disappear. To this end the hygienic conditions by which the patient is surrounded should be considered. If tonics, as quinine or iron are indicated, they should be administered; the secretions also should be attended to, and all external and internal causes which may prove detrimental to health removed. The *local* treatment consists in absolute cleanliness and the removal of all retained secretions; for this purpose there is nothing equal to the use of the douche with (Fig. 299), saline medicated lotions. The inhalation of steam will at times assist the removal of the secretion and relieve the state of fulness of the part of which some patients so much complain, especially if the discharges have a tendency to desiccate, adhere to the mucous lining, and, as a consequence, to putrefy; since it is this putrefaction of the retained muco-purulent secretion on which essentially depends the condition denominated *ozæna*. Medicated lotions are sometimes required, such as iodine or boracic acid lotion, ten drops or grains to the ounce; Condy's fluid, carbolic acid, the sulphate or chloride of zinc, or nitrate of silver, in the strength of about one grain to the ounce of water. The inhalation of the fumes of iodine is always useful.

Local.

Treatment where ulceration.

When ozæna is associated with some ulceration of the passage, an ulceration that may be seen through the speculum, and, if not seen, suspected to exist when an occasional escape of a blood-stained mucopurulent secretion takes place, tonics are still called for, with cleanliness locally; topical stimulants being employed when simpler means have failed, or, when great indolence of the part is present.

These cases are, however, very obstinate, and much time is frequently required to bring about a cure—several months being often not long enough; but the fetor, which is the chief symptom of annoyance to the sufferer, may speedily be removed by the mechanical and local means already suggested, and so the worst feature of the disease becomes destroyed, and the mental as well as the physical comfort of the patient secured.

May end in necrosis.

When, however, this inflammatory action and perhaps ulceration is allowed to continue, a different result will ensue; the bone itself may become involved, and as a result, necrosis follows. In so-called strumous subjects, this condition is not infrequent. I have, however, no evidence to give that such a necrosis is always the result of the extension of the inflammation from the soft parts around the bone to the bone itself. In many cases, I believe, if not in the majority, the disease originates in the bones.

Necrosis may originate in bone.

May result from injury or syphilis.

Necrosis of bone in the nose is not an unfrequent condition, and, as such, is another cause of the disease described as *ozæna*. It is found in children as well as in adult life, and may be the result of injury, extension of disease from the soft parts covering the bones or associated with the so-called strumous diathesis, or with the syphilitic poison. Occasionally it takes place wilthout any such distinct cause, when it is described as idiopathic; it being well known, that inflammation of bone may arise *per se*.

Fetor peculiar.

When ozæna is the result of necrosed bone, the fetor is generally of a peculiar character, such as is well known to accompany diseased bone; and under these circumstances, by careful examination with the speculum or probe, bare bone will often be detected, by which the nature of the disease becomes tolerably evident. In early life I believe that inherited syphilis is a more frequent cause of this affection than is generally suspected, and this opinion has been confirmed by the presence of other marked symptoms in some cases, such as old skin diseases, syphilitic teeth, or keratitis.

Diagnosis.

To form a correct opinion in all cases of ozæna, a careful history of the case must be obtained and well-known symptoms not overlooked, for unless an accurate knowledge of the case can be acquired, the treatment adopted must be doubtful, and consequently unsuccessful.

Treatment.

Tonics; iodine.

Perchloride of mercury.

TREATMENT.—When the presence of necrosed bone has been made out as the cause of the disease called ozæna, it is tolerably evident that the patient will not recover until the fetid bone has been removed, or rather has exfoliated. To this end the preservation of perfect cleanliness by means of the douche or syringe, with or without stimulating or antiseptic lotions, may be employed, and tonics should be administered. If syphilis, either hereditary or acquired, is the apparent cause, our remedies must be modified to the general requirements of the patient. Mercurials are seldom necessary, although in children suffering from this disease, where the history and other symptoms of congenital syphilis are present, I have given them, associated with tonics, with marked benefit, and, in obstinate cases in adult life, such a combination may also be employed. The perchloride and green iodide have proved the best forms in my experience, and, when combined with tonics, such as quinine, bark, or iron, are invaluable. I generally prescribe the perchloride with bark, and the iodide in pills at bedtime, the patient taking at the same time the syrup of the iodide of iron and the iodide of potassium in some bitter infusion, such as quassia. If mercurials are not indicated or required, the combination of the iodides of iron and potassium cannot be too highly valued.

In strumous subjects, perfect local cleanliness, and perhaps stimulants, accompanied with tonics, as cod-liver oil, quinine, or iron alone, or in combination, generally suffice. In exceptional cases an operation may be required for the removal of the dead bone, and where by forceps the bone cannot be taken away, Rouge's operation (*vide* p. 9) may be performed.

Diseases of the frontal sinus.

Disease of the Frontal Sinus.

Inflammation.

The frontal sinuses, as part of the nose, are liable to many of its diseases. Acute or chronic catarrhal inflammation is by no means uncommon; both giving rise to a dull heavy pain over the forehead, which the inhalation of the fumes of half a grain or more of opium thrown on a hot piece of metal often speedily relieves.

Suppuration.

Acute suppuration of these sinuses is occasionally met with, and is attended with severe local and general symptoms. Under these circumstances, the application of the trephine to the outer shell of bone may be required. Necrosis of the bones covering in the sinuses may exist, and the latter are also liable to fracture.

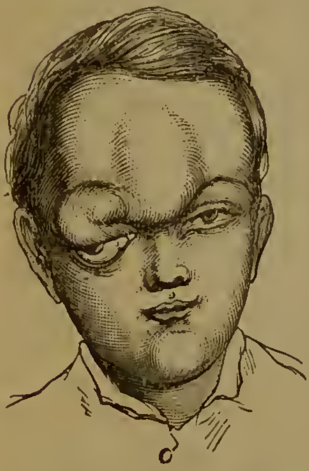
New growths.

New growths may likewise be found in this locality—cancerous, myeloid, or bony; *the ivory osseous growths* being more frequently found in the air-cells of the frontal bone and nasal fossæ than in any other locality. From modern investigations they appear to have a periosteal origin and soon become loose. In Hilton's well-known case the growth sloughed away.

Enostosis.

In the case of my own, from which Figs. 306 and 307 were taken, the osseous mass was evidently dying when it was removed. It had been growing in the frontal sinus of a man, æt. 24, for four years, and had gradually encroached upon the orbit. I enucleated it from its bed by means of an elevator, after having taken away the layer of frontal bone that covered it in. A good recovery ensued ('Guy's Hospital Reports,' 1873-4). M. Olivier's treatise upon the subject, published in Paris in 1869, gives all the facts known about such growths.

FIG. 306.



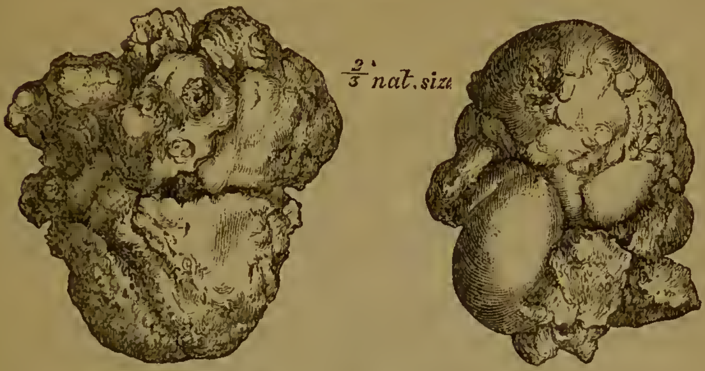
Enostosis of frontal sinus.

In all tumours occupying the centre of the frontal region in children the possibility that any one may be a hernia of the brain and its membranes should be borne in mind.

Distension of sinus.

Distension of the frontal sinus is an affection not sufficiently known, indeed, it has been described only by Lawson and Higgens. It shows itself as a chronic swelling, or expansion of the bone near the inner angle of the orbit above the lachrymal sac, and is attended at times with pain of a dull aching character. Occasionally the affection is painless or the pain is intermittent. Occasionally with the swelling there is some watering of the eye, and in rare cases the eyeball is pushed outwards. Injury is said by Lawson to be its common cause, but in the three cases I have seen it came on by itself. When injury has been the cause it was probably a fracture, the fracture bringing about a closure of the communication between the middle meatus of the nose and frontal sinus. The swelling contains a more or less purulent tenacious fluid.

FIG. 307.



Enostosis after removal.

Diseases and injuries of the eye.

Distension of the frontal sinus, writes Higgens, "has probably no early symptoms. There is at no time severe pain, nor, indeed, any, until the disease has far advanced." Indeed, it is probable that the disease is not to be recognised until the orbital wall of the sinus begins to bulge, or the bone has so thinned as to allow the distended sinus to appear as a soft fluctuating swelling with a raised bony and clearly defined margin. In one of my cases this condition was very marked.

'Guy's Hosp. Rep.,' vol. xxv, 1881.

When the swelling is hard and bony it may be mistaken for an osseous growth, such as is figured in Fig. 306. When it is soft and fluctuating it may be regarded as an abscess connected with the lachrymal sac. When the bone has thinned and gives a crackling sensation on pressure, or when, as noted above, a soft fluctuating swelling surmounts an elevated bony ridge its true nature is rendered probable, and when the tumour varies in size at different times of the day, the diagnosis is certain, this variation in size being, according to Higgens, "due to the fluid becoming—when the patient lies down—evenly diffused throughout the sinus, whilst it gravitates to the part after the erect position has been maintained for a few hours."

Diagnosis.

TREATMENT.—There is but one kind which can bring about a cure, and that is the free opening of the swelling and its efficient drainage into the nose, which should be guaranteed by the introduction of rubber tube. The cavity should be washed out daily with some antiseptic. In two of my three cases a cure was effected by these means after the lapse of months. In one case the sinus through the forehead is still open.

Treatment.

Rhino-plastic or Taliacotian Operations.

Rhino-plastic operation.

Gaspar Tagliacozzi, or Taliacotius, Professor of Anatomy and Surgery in the University of Bologna, was the first to bring these operations into notoriety, and they have consequently been named after him. He was not, however, the originator of the operation, as he himself refers to earlier men, such as A. Parè and others, who have recommended it, but he was the first to practise it with much success, and quite deserves the fame that attended his efforts. His principal work, published in 1597, at Venice, only two years before his death, gives the histories of the cases in which he operated.

His method consisted essentially in taking a flap of skin from the arm and transplanting it to the nose, and so restoring that organ to its normal appearance where there had been any loss of substance.

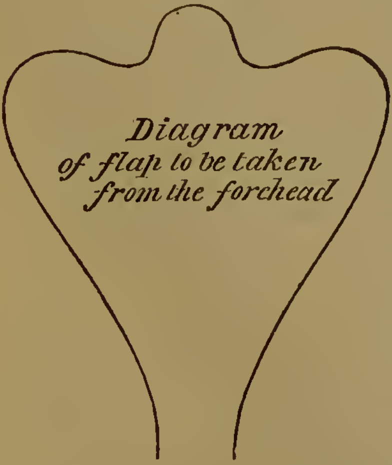
Indian method.

Mode of performance.

Flap to measure three inches in both diameters.

Modern Surgeons, instead of following the great Italian example, generally prefer to adopt the Indian method, and take the integument from the forehead. The operation is by no means common. It may be undertaken to restore the nose wholly or in part, and the amount of healthy integument required for this purpose will be regulated by the want. The ingenuity of the Surgeon, too, will be taxed in every case to adapt his operation to its special requirements. He must, however, always be careful to give himself abundance of new material; and, having satisfied himself of the wants of the individual case, and that the parts upon which he is about to operate have long lost all traces of disease, he can then map out upon the centre or lateral portion of the forehead of the patient that portion of integument he proposes to transplant, having planned it beforehand on a piece of paper, plaster, or wash-leather. The shape required for a nose and columna will be such as is indicated in Figs. 302 and 308, the flap measuring three inches in each diameter. The Surgeon shall then make raw the whole surface of the old nose, to which the flap is to be united, cutting a deep groove close down to the bones bounding the nasal cavity for the reception of the new flap. A sponge may then be firmly pressed upon this raw surface to arrest the bleeding, while the Surgeon proceeds to dissect up the integument he had previously marked out upon the forehead. In doing this care should be observed not to bruise or otherwise injure this borrowed skin. The incision should be clean, and extend down to the bone. The flap should be dissected up boldly and freely, care being observed to leave a good neck, through which the circulation can be maintained, and to make it long enough to allow of its being turned round. For this purpose it is a

Fig. 308.



good practice to make the incision on the side to which the twist is to be made a little longer than the other.

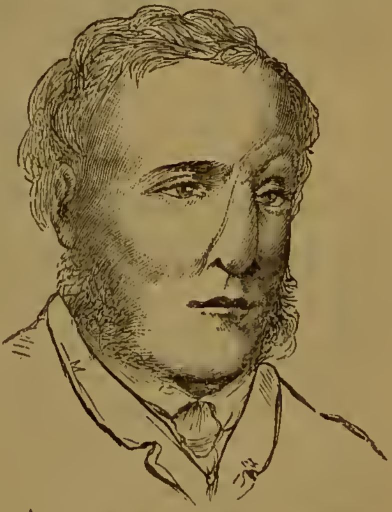
When all bleeding has ceased, the frontal flap with the external surface still uppermost should be turned half round, and applied to the nasal raw surface, to which it is to be carefully stitched; the columnar portion being well pressed down into the groove made for it, and fixed. The new nostrils ought to be supported by oiled cotton wool or lint, and the surface covered with the same sort of material to maintain its warmth. The gaping wound on the forehead can then be brought together as far as possible by means of strapping, and left to heal by granulation—the operation of skin grafting expediting repair. The sutures may be removed on the second or third day. For the next month the greatest care is requisite in the dressing of the wound, and in keeping the nostrils up with a plug, the one suggested by Langenbeck being the best; and, as soon as the new flap has consolidated, the neck of integument at the root of the nose may be divided. In the case illustrated (Fig. 309) such a practice was not called for. I operated upon it in 1872 with an excellent result. When the formation of the columna is required, Liston's plan is the one generally employed, and is thus described in his own words:

On restoration of the columna.

"Restoration of the columna is an operation which, in this and other civilised countries, must be more frequently required than the restoration of the whole nose. This latter operation came to be practised in consequence of the frequency of mutilations as a punishment; but the punishment for some of our sins is left to Nature, and she generally relents before the whole of the organ disappears. This columna is frequently destroyed by ulceration. The deformity produced by its loss is not far short of that caused by destruction of the whole nose. Happily, after the ulceration has been checked, the part can be renewed neatly, safely, and without much suffering to the patient. The operation which I have practised successfully for some years, and in many instances, is thus performed:—The inner surface of the apex is first pared. A sharp-pointed bistoury is then passed through the upper lip—previously stretched and raised by an assistant—close to the ruins of the former columna, and about an eighth of an inch on one side of the mesial line. The incision is continued down, in a straight direction, to the free margin of the lip, and a similar one, parallel to the former, is made on the opposite side of the mesial line, so as to insulate a flap about a quarter of an inch in breadth, and composed of skin, mucous membrane, and interposed substance. The frænulum is then divided, and the pro-

Liston's operation described.

Fig. 309.



Appearance of face after formation of new nose.

labium of the flap removed. In order to fix a new columna firmly and with accuracy in its proper place a sewing needle is passed from without through the apex of the nose, and obliquely through the extremity of the elevated flap; a few turns of thread over this suffices to approximate and retain the surfaces. It is to be observed that the flap is not twisted round, as in the operation already detailed, but simply elevated, so as to do away with the risk of failure. Twisting is here unnecessary, for the mucous lining of the lip, forming the outer surface of the columna, readily assumes the colour and appearance of integument, after exposure for some time. The fixing of the columna having been accomplished, the edges of the lip must be neatly brought together."

The sutures can be removed on the third or fourth day, when, as a rule, the parts have cicatrised. The ultimate result of the case depends materially upon the care bestowed upon its after-treatment. In the case illustrated in Fig. 309, which I operated upon several years ago, a gratifying result ensued, the bridge of the nose requiring no second operation. Dr. Lichtenberg has had within the last few years some very successful cases; and the late Mr. Skey had some excellent results in his practice. I saw one that he had operated upon years before, which was very excellent. It is well, however, to remember Mr. Skey's advice when he says, "Let it be the patient who urges the operation."

Of late years, Langenbeck has suggested the propriety of dissecting up the periosteum from the frontal bone with the skin flap so as to give a bony nose, but it is a question how far this osteo-rhinoplasty is an advantage. The operation has not found much favour.

When only one ala has to be restored, the flap may either be taken from the nose itself or from the cheek, the particulars of the plan being left to the ingenuity of the Surgeon to determine.

CHAPTER XVIII.

SURGICAL AFFECTIONS OF THE LARYNX AND TRACHEA.

Fracture of larynx.

THE larynx and windpipe may be contused from external injury, or, the cartilages and trachea rings fractured; the nature and severity of the symptoms following these accidents varying with the character and the amount of injury; some years ago, a case came under my care in which the *thyroid* cartilage was fractured obliquely across the body. The accident was attended with much bleeding and cough, but these soon disappeared, and an excellent recovery ensued. In 1877, Dr. A. Corley, of Dublin, recorded a case, in which after death the second, third, and possibly the fourth cartilages of the trachea were fractured and projected unevenly into the tube, associated with suppuration around a necrosed cricoid cartilage. The preparation was taken from a woman, æt. 36, who had been squeezed in the throat some *weeks* before, and was admitted into the Richmond Hospital with dyspnœa, stridulous breathing, congestion of face, and external signs of inflammation about her throat, and for which tracheotomy had been unsuccessfully performed. There is more danger when the cricoid cartilage is involved than the thyroid.

Subcutaneous division of trachea.

The trachea may also be *completely divided subcutaneously.* I saw this in June, 1876, at Guy's Hospital, in the case of a man, æt. 47, who was crushed between a barge and the side of a vessel, the prow of the barge striking his neck. The accident was followed by dyspnœa and some emphysema of the neck, but the symptoms were not urgent so long as the erect position was maintained, but the recumbent was impossible. The man lived fifty hours and died quietly. After death, the trachea was found to be completely severed below the thyroid body; the two ends being separated for an inch and a half, while the lower end was below the innominate vein.

There was no external bruise to denote the severity of the injury.

Wounds of the Throat.

Wounds of the throat.

These are generally made by the hand of the suicide, and consequently have a double interest; the dangers of the local injury being complicated with the peculiar mental condition of the sufferer. It is essential, therefore, for the Surgeon to dwell seriously beforehand upon the necessities of these cases, in order that he may be prepared to act with decision in the hour of danger.

Superficial.

In the majority of cases of "cut throat" the wound is only of a superficial nature, and simply involves skin, or skin and muscle, and does not implicate either the pharynx or the respiratory tract. These cases require no other local treatment than that usually employed for skin wounds, such as sutures and some simple dressing.

Deep.

When the wound is of a deeper character, it may penetrate into the pharynx and air-passages, or involve the deep vessels, the dangers of the case being much determined by the position of the wound.

My colleague Mr. Durham in an able article in 'Holmes' Surgery,' (3rd Ed.) shows, that of 232 unselected cases the wound was

Above the hyoid bone in . . .	17	cases.
Through the thyro-hyoid membrane in .	80	,,
Through the thyroid cartilage in . .	42	,,
Through the crico-thyroid membrane in .	36	,,
Into the trachea in	57	,,

The respiratory tract was opened in about two thirds of the cases.

Hæmorrhage may occur.

In all cases of cut throat, *hæmorrhage* as the direct result of a divided or wounded artery or vein is to be apprehended; and, although from the deep position of the carotid artery and jugular vein these vessels in the majority of cases escape injury, yet when they are divided death is usually rapid. Partial or complete division of some of the branches of these vessels is, however, not unfrequent.

Examples.

A man in Guy's, æt. 21, in a fit of despondency cut his throat, and died from profuse hæmorrhage into the lung before help could be obtained. The blood was found after death to have come from a divided superior thyroid artery. An inmate of St. George's divided the left common carotid artery and wounded the internal jugular vein with a penknife, and died before the house Surgeon could arrive. "A gentleman, who committed suicide by cutting deeply between the os hyoides and thyroid cartilage, partially divided the external carotid artery on the right side, just as it was given off; the flow of blood was immense, and he was found dead within ten minutes of the infliction of the wound." (Fothergillian Prize Essay for 1836, by my father, the late Mr. T. E. Bryant.) In Guy's Museum, Prep. 1711^{79}, the left internal jugular vein may be seen divided; the cut being between the thyroid and cricoid cartilages, and proving speedily fatal. Prep. 1711^{9} shows division of the inferior thyroid artery.

Hæmorrhage into trachea.

Blood may flow into the trachea and, suddenly or slowly, cause asphyxia; it may coagulate over the orifice of the larynx with the same result. Mr. Le Gros Clark has also shown ('Surg. Diag.,' 1870) how air may enter the circulation through a partially divided vein and destroy life in twenty-four hours.

Division of the tongue.

When the incision is *above the hyoid bone* and deep, the tongue may be divided, and the loosened portion by falling over the orifice of the larynx may cause sudden death by suffocation. In wounds of this description, the Surgeon should consequently guard against the possibility of this contingency by passing a thread through the tongue and drawing it forward.

Epiglottis cut.

When the cut is *just above the thyroid cartilage,* the epiglottis may be divided, and this falling into the larynx may cause fatal dyspnœa. To prevent this a stitch should be inserted into the divided portion and the parts adjusted. The same result may take place when any portion of the orifice of the larynx has been detached. Indeed, all loose bodies likely to obstruct respiration should be fixed. Emphysema is by no means an uncommon complication of cut throat when the respiratory tract has been opened, and is not, as a rule, a dangerous occurrence. It is more common when the external wound is small.

Secondary dangers.

Inflammation of the air-tubes and lungs is the secondary danger of wounds of the throat involving the air-passages; and, when the pharynx or œsophagus has been opened, this risk is aggravated by the possible introduction of food into the trachea. It "was the cause of death in 17 out of 21 fatal cases of cut throat consecutively treated at Guy's Hospital, in which the more immediate effects of the injury had been survived" (Durham). Purulent infiltration of the cellular tissue of the neck may also ensue, or œdema of the glottis; and, at a later date, the air-passages may be obstructed by the cicatrisation of the wound or the contraction of the trachea. In exceptional cases a permanent fistulous opening may be left.

General summary.

The immediate danger of a wound in the throat consequently depends (1) on the quantity of blood lost; (2) on the risk of suffocation from blood flowing into the air-tube; (3) the danger of suffocation by tissues divided and partially separated from their connections obstructing the larynx. The secondary dangers are those of œdema of the larynx and inflammation of the air-passages, and, later on, from subsequent obstruction of the divided tube by the contraction of new tissue around it, or the growth of exuberant granulations round the wound.

Treatment.
1. Arrest hæmorrhage.

Treatment.—The first duty of the Surgeon under all circumstances is to *arrest hæmorrhage.* Arteries ought to be ligatured or twisted, so also all deep veins when moderate pressure fails to check the flow of blood. A wounded artery or vein should be ligatured above and below the wound. To tie up an opening in a large vein with a lateral ligature is bad practice.

To find the bleeding vessel, the wound may have to be enlarged. The internal jugular vein may be ligatured with a good prospect of successful result. Durham states that out of 72 cases 48 recovered. Gross has demonstrated the soundness of the practice ('Amer. Journ. of Med. Science,' 1867).

2. Prevent suffocation.

The second duty of the Surgeon is to *prevent suffocation.* He should see that the respiratory orifice is kept clear of blood, or of any divided structure, such as the tongue or epiglottis. Coagula ought to be speedily removed, and respiration encouraged by artificial means when natural processes have failed.

3. Adapt the divided tube in position.

When the larynx or trachea has been wounded, the aim of the Surgeon should be to keep the divided pieces of the tube in continuity and not to allow the upper portion to overlap the lower, and thus obstruct the respiration; at the same time care must be taken to keep the wounded parts sufficiently open to allow of the escape of the mucus, which is always profuse, and to permit the free ingress of air.

Sutures.

Head to be bent forward.

Warm and moist atmosphere.

If the wound is very extensive, and difficulties arise in carrying out the above indications, sutures may be introduced; but it must be left to the Surgeon's judgment to decide when they may be necessary, according to the exigencies of the individual case. In large wounds, where the parts cannot be kept together, a suture is often of immense benefit, and sutures when applied should be put in firmly, including often the whole thickness of the tissues. Their object can only be to fix the divided parts in position, and to prevent, by their sudden movement, any mechanical obstruction to the respiratory act. To do this effectually, the measures employed should be boldly executed. The head should be kept forward by the application of bandages, and water dressing applied to the wound itself; constant attention is demanded of the nurse to keep the wound clear of discharge, and to see that no obstruction to the breathing takes place. The atmosphere the patient breathes should be kept warm and made moist by the introduction of steam, and the wound covered with muslin. The closest attention should be paid to the patient by a skilful nurse, and every mental and bodily want or weakness cared for. As regards nourishment, abundance should always be provided, although it is not such an easy task for the patient to take it.

When œsophageal tube required.

When the pharynx or œsophagus is extensively opened, the patient should never be allowed to swallow, but be fed by means of a tube passed either through the nose or mouth, and not through the wound, and directed with the finger carefully down the throat into the lower portion of the œsophagus. Through this, beef tea, eggs, brandy, and other liquid nourishment, such as the symptoms indicate, may be periodically administered. I have an instance before me of this kind, and where the patient was kept alive by such means for nearly six weeks, the tube having been passed through the nose. At the end of this time he was able to swallow, and recovery ensued. When acting as dresser to the late Mr. Aston Key, I had a case where the wound was inflicted through the trachea, dividing the œsophagus. In this instance the man was fed twice daily through a tube passed through the mouth and directed with care into the lower œsophageal opening; this practice being carried on for many weeks was rewarded by recovery. The plan of treatment just indicated, however, is only rational, and is such as any Surgeon would naturally suggest. All complications, such as suppuration in the cellular tissues around the wound, bronchitis, or broncho-pneumonia, are to be dealt with as they arise. Some have suggested the propriety of tracheotomy in severe cases of cut throat, so as to allow the wound to be closed. I am unable, however, to see the advantages offered by this practice in ordinary cases; although in wounds involving the epiglottis or upper part of the larynx, when inflammatory œdema appears as a secondary result, causing obstruction to respiration and threatening life, there is no doubt as to the wisdom of the practice. These cases, however, are uncommon.

Tracheotomy in cut throat.

Contraction and fistulæ after wounds.

Among the most remote dangers of such wounds, the mechanical obstruction of exuberant granulations ought to be mentioned; likewise, some narrowing of the air-passage, from contraction of the cicatrix; and tracheal fistula. These results are common to traumatic and surgical wounds of the part. In Prep. 1711[11], Guy's Hosp. Museum, taken from a patient who had lived for many years after a wound which had involved both the trachea and œsophagus, both the trachea and œsophagus are much contracted above the opening, and, in a less degree, below. In 1873 I was called upon to perform tracheotomy on a man, æt. 57, who had cut his throat through the thyroid cartilage sixteen months previously; for eight or ten months he had been suffering from gradually increasing difficulty of breathing, due to the contraction of the air-passage, and this patient has ever since been obliged to wear the canula. In the seventh vol. of the 'Clin. Soc. Trans.' an interesting case of the kind has been recorded by Mr. H. Lee.

Foreign Bodies in the Windpipe.

Foreign bodies in the windpipe.

There are few accidents which excite more anxiety and alarm to a looker-on than the passage of a foreign body into the larynx or trachea, since the unfortunate subject, in the midst of apparent health or happiness, is suddenly forced to make violent struggles for life. To the spectator death seems imminent; and in the Surgeon no less painful feelings are excited, for unless by his art timely relief can be afforded, the danger which is apparent becomes real, and death is almost a certainty.

Frequency in children.

The majority of the victims of such an accident are children, although adults are not exempt from such a contingency.

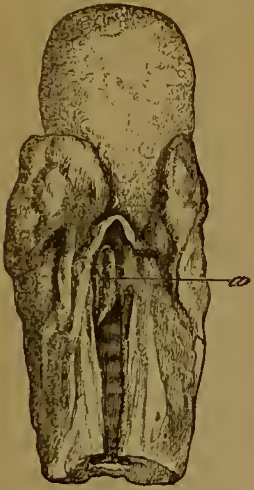
Mode of entry of foreign body.

A foreign body may be inhaled at any moment; a sudden inspiration being sufficient when the mouth is full, or holds a foreign body which is smooth, light, or small, such as a seed, fruit stone, bead, bean, nut, or coin. Vomited matter may likewise be drawn by inspiration into the air-tubes by patients in a state of unconsciousness, as when drunk under an anæsthetic, or in an epileptic fit. Foreign matter may likewise find an entry into the respiratory tract through a fistulous opening between the œsophagus and trachea, the result of simple or cancerous ulceration. The body may be lodged at the orifice of the larynx (Fig. 310), and thus cause sudden asphyxia; or pass into the rima or ventricle, where it may be arrested, and give rise to spasm or cause œdema, and, as a consequence, more or less gradual obstruction. It may likewise pass into the trachea or bronchi, the right bronchus being its most common seat, and become either impacted or remain movable. The size and shape of the foreign body determines many of these points; for whilst a large one will naturally be arrested at the orifice of the larynx, a small one will probably pass through. A jagged and light body, such as a seed or piece of nut-

Situation of the foreign body.

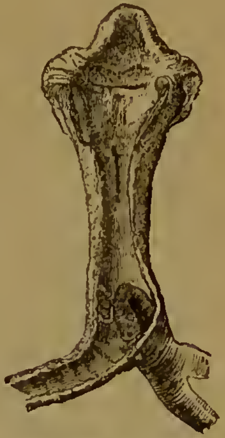
shell, would be more likely to be caught in the rima than a small round body, such as a bean. A light body will remain movable, whereas a heavier one may become impacted.

Fig. 310.



Bone in larynx causing death, taken from a child 11 months old. Prep. 1710^{5}.

Fig. 311.



Date stone impacted in right bronchus. Prep. 1717^{15}.

A piece of meat may become impacted in the rima glottidis, and cause instantaneous death (Prep. Guy's Hosp. Mus. 1710).

In the case of a child, æt. 2½, on whom I unsuccessfully operated in 1864, a date stone was found impacted in the right bronchus, while its upper end was pressing against the left side of the trachea, and exciting ulceration (Fig. 311). The child lived four days. In another case, recorded in my 'Clinical Surgery,' Part II, a bean was firmly impacted in the right bronchus, causing complete obstruction to the right lung.

Most frequent in right bronchus.

The fact pointed out by Goodall, of Dublin, that the septum at the division of the trachea is somewhat to the left of the median line is probably the explanation of the right bronchus being more frequently the seat of the foreign body than the left. The larger size of the right bronchus doubtless favours this tendency.

Symptoms.

The symptoms which attend the entrance of a foreign body into the air-passages are somewhat characteristic, although those that follow are often obscure. The most typical is a violent convulsive cough *coming on abruptly*, followed by difficult respiration, and a feeling of suffocation—this spasmodic cough being likely to recur at intervals on any movement, and as long as the foreign body is loose.

Sudden fits of cough.

Altered voice.

When the foreign body is lodged near the rima, and impacted, the voice is altered in character, *whistling* or *stridulous;* and there may be some tenderness of the larynx on manipulation or pain. When an extraneous body is in the ventricles, the spasmodic derangement to which it gives rise too often proves speedily fatal. In children, rapid suffocation is a common result of such a cause, death being more frequent from spasm of the glottis than from mechanical obstruction by the foreign body; though when the body is fixed in the larynx, chronic obstruction often comes on from the œdema of the larynx excited by its presence.

Variation in breathing.

When the breathing of the patient is at times natural, and at others disturbed by a paroxysm of cough or dyspnœa, and when these symptoms are brought on by any movement or violent respiratory effort, it is probable that the foreign body is loose in the trachea or in one of its divisions; indeed, patients are conscious occasionally of the movement of the body. When by auscultation it can be made out that air enters one lung freely and the other feebly, the exact seat of impaction of the foreign body is indicated, and the amount of dyspnœa present will depend upon the tightness of the impaction.

Auscultation.

When the extraneous body has passed through the larynx into the trachea, there may be long intervals of repose between the attacks of laryngeal spasm; but any spasm may prove fatal.

Examples of impaction without symptoms.

Many cases are now on record in which foreign bodies, particularly coins, have been impacted in a bronchus, and have given rise to no urgent symptoms for years. Dupuytren in one of his lectures given in 1833 relates a case where a coin was known to have been in the air-passage for ten years without producing any very distressing effects, and was found after death to occupy a tubercular excavation. Professor Gross gives a case in which a portion of bone is said to have been coughed up, after having been retained for sixty years. Cases such as these, however, should never allow the Surgeon to rest satisfied, or permit a foreign body to remain in the air-passages; for so long as it does, death may at any moment be suddenly produced by convulsive laryngeal spasm, or more slowly by broncho-pneumonia.

Foreign bodies in œsophagus may cause dyspnœa.

Difficulty of breathing is not uncommon as a consequence of the arrest of food in the œsophagus or lower part of the pharynx, and at first sight, the Surgeon might think that the symptoms are due to the presence of some foreign body in the air-passage. When doubt exists, the patient should be made to swallow; in laryngeal obstruction no difficulty will be experienced by the act, whereas in pharyngeal it will be impossible. Under other circumstances a probang may be carefully introduced into the œsophagus, and, in every case, a careful exploration of the throat and pharynx with the finger should be made. When the foreign body is impacted in the pharynx and cannot be removed, and laryngeal spasm threatens life, the windpipe may require to be opened. The Surgeon should always hesitate to employ force in pressing a foreign body downwards.

Treatment.

Treatment.—Given the diagnosis of a foreign body in the windpipe, the duty of the Surgeon plainly is to endeavour to remove it. There should be no deviation from this resolution, because so long as a foreign body remains in the air passage sudden death from spasm of the larynx is imminent, and the first spasm may prove fatal; the spasm being produced by any movement of the foreign body. The Surgeon should never allow himself to be misled by the mildness of the symptoms nor by the knowledge that in rare instances foreign bodies have remained in the passage for years, and even then been expelled, since such cases are exceptional. The accident is one that will inevitably destroy life, although it must be doubtful at what time, or in what form, danger may appear.

Tracheotomy.

In all urgent cases in which spasm of the larynx threatens life, *tracheotomy* should be performed; because with an opening in the trachea, a fatal spasm is impossible, and the Surgeon may then proceed to investigate the case. In cases in which life appears to be extinguished the same practice should be adopted, artificial respiration being subsequently maintained. Should the symptoms point to the larynx as the seat of the impaction, the upper orifice should be closely examined by the finger introduced through the mouth, and a full-sized bougie or catheter, or what is better, a small piece of sponge held by forceps or fixed on a handle introduced from below through the wound into the larynx. By these measures most foreign bodies caught and impacted in the larynx itself may be removed. In exceptional cases where these measures fail, the Surgeon may be called upon to lay open the larynx. The laryngoscope at times will be an invaluable aid in guiding to the position of the foreign body and in effecting its extraction. It is only applicable, however, in adults. When the position of the foreign body is known, its removal may be facilitated by curved forceps.

Further measures to be adopted.

Laryngotomy is scarcely applicable to these cases, the majority being found in children. In children, the opening in the trachea should always be as high as possible, and there is no objection to dividing the cricoid cartilage (*laryngo-tracheotomy*) to reach the larynx. When the foreign body is so fixed in the larynx as to be immovable by the means suggested, the thyroid cartilage must be laid open by increasing the incision upwards. In doing this the larynx will be fully exposed, and the removal of the body facilitated. When the foreign body has passed the larynx and is in the trachea, a free opening should be made low down in the passage, and when this is done it not unfrequently happens that the foreign body is expelled. Should this not happen, and the foreign body is heavy and smooth, the patient may be inverted, and succussion employed, that is, the patient should be patted sharply on the back or shaken with the view of dislodging it. But this proceeding should not be employed until the trachea has been opened. Should the foreign body be light, it may possibly be extracted by means of the "sucker" figured 316A at page 35. The rubber-tube for this purpose should be long.

Laryngo-tracheotomy.

Enlarging of the wound.

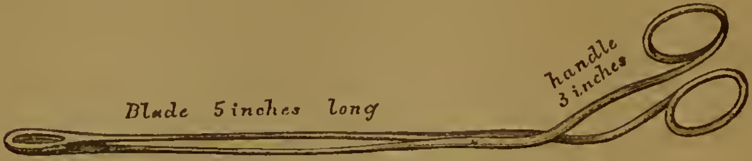
Succussion.

Some Surgeons advise the introduction of forceps or other instrument through the wound into the trachea for the removal of the foreign body, and in recent times success has followed the practice. Thus in May, 1876, Mr. Maunder extracted, by means of a loop of silver wire through an opening made in the trachea, a glass sleeve-link from the left bronchus of a boy æt. 13. Mr. Hulke, in August, 1876, hooked out of the right bronchus of a woman, æt. 37, the outer tube of a tracheotomy canula by means of a piece of German silver wire bent into a hook; and Mr. Lucas, on November 16, 1877, removed by means of forceps the same kind of thing from the left bronchus of a man æt. 57, the tube having been in the bronchus for seven weeks.

Use of forceps.

Fig. 312 represents an excellent pair of forceps for this purpose. It was made for Dr. S. D. Gross, of Louisville, before 1854, and is taken from his book on 'Foreign Bodies in the Air-passages.' "They," as described by him, "are composed of silver, and are a little upwards of eight inches in length. The handle is considerably curved on the flat, and has two large rings for the thumb and finger. The blades, which are rounded and very slender, are five inches long and terminate each in a fenestrated extremity, nine lines in length by three lines width, the outer surface being smooth and convex, the inner flat and slightly serrated. The blades when shut slightly overlap each other. The weight of the instrument is a little over five drachms. The instrument, being long and slender, may be used as a probe; being composed of silver may be bent at any point and in any direction; and being delicate cannot impede the passage of air during its use."

FIG. 312.



Gross's trachea forceps.

When these means fail to remove the foreign body, the patient must be left; but the wound in the air-tube should be kept open.

Use of canula.

Valvular opening in trachea.

Statistics of operative and non-operative interference.

Treatment after removal of body.

If the foreign body be in the larynx, the canula may be introduced, but when in the trachea or bronchus, its retention is injurious, as it prevents the escape of the substance. Under these circumstances Hilton's suggestion to form a transverse valvular opening in the trachea is undoubtedly the best since it readily allows the escape of the foreign body when impelled against its surface. The cutting out of a portion of the trachea is quite unnecessary. A better practice consists in making some provision for the tracheal wound to be held open by hooks, by some such apparatus as Golding-Bird's tracheal dilator. In one case in which the trachea was deep I managed to keep the tracheal wound open by means of a divided ring of strong wire embracing the neck, its two ends being made to hook into the opening in the air-passage, and acting as retractors. In another I held the wound apart by means of a wire instrument made on the principle of the eye speculum. When efforts fail at one time for the removal of the body, they may be successful at another. Mr. Brunel's well-known case is one in point. Mr. Durham informs us from an analysis of 636 cases of foreign bodies in the air-passages, that death resulted in forty-one per cent. when no operation was performed, and in twenty-three per cent. when operative measures were resorted to; and hence the chances are greatly in favour of the latter practice. The foreign body having been removed, the chief danger has passed. There may be some inflammation of the air-passage as a result of the irritation of the foreign body, but this usually subsides on the removal of its cause; in exceptional instances it may prove troublesome, if not fatal. The nature of the substance has also much influence in determining this result, smooth bodies being slightly irritating, while jagged are more so. The operation of tracheotomy doubtless does something towards aggravating the tendency to inflammation. Such a complication should be treated on rational principles, but in the majority of instances the inflammation will subside spontaneously on the removal of the offending body. Water dressing to the wound, and a warm, moist atmosphere, are the two essential points of practice to be attended to after the removal of the cause, and, as a rule, convalescence speedily follows. Anæsthetics ought always to be administered in these cases when operative interference is called for.

Scald of the Larynx.

Œdema of glottis from scald.

This somewhat common accident is engendered amongst the poor from the habit of feeding their children out of a teapot. The child, when thirsty and alone, being accustomed to drink from the "spout," tries the same experiment with the kettle of boiling water, and scalds the pharynx and orifice of the larynx, so that œdema of the part follows, in the same manner as a blister arises by the application of boiling water or steam to any other tissue.

The symptoms caused by such an accident appear, as a rule, very speedily, and the small chink of the glottis soon closes; as a consequence, a fatal result ensues, unless early relief can be obtained.

Symptoms.

In some cases the mouth, with the soft palate, tongue, and fauces, will be found swollen and vesicated. There will also be difficulty in swallowing, and some alteration in the character of the voice. The respiration rapidly becomes affected, and a spasmodic croupy cough appears, with stridulous breathing. These symptoms may become gradually or rapidly worse, and may be complicated with attacks of spasmodic dyspnœa, at long or short intervals; but when these attacks appear, the condition is extremely dangerous, as any spasm may prove fatal. A somewhat similar result may arise from the intentional or accidental swallowing of any corrosive poison or acid, or from the inhalation of a flame.

Treatment.
Mild means.

Treatment.—In a fair proportion of these cases little other treatment than a warm bed, the application of a hot sponge to the larynx, and the inhalation of warm moist air, is ever needed; the symptoms subside as rapidly as they appear, three or four days seeing the worst of the case; and, in these mild cases, the laryngeal symptoms are probably never severe. When laryngeal symptoms exist, accompanied by spasm, the case assumes a threatening aspect; indeed, the first spasm may be the last. I have notes of the case of a child in whom the symptoms were so slight that no anxiety was felt, but a single spasm took place two hours and a half after the accident, and put an end to life.

Tracheotomy.

When symptoms are severe the operation of tracheotomy should be performed; indeed, I am disposed to recommend this operation in every case in which the symptoms are progressing, and laryngeal spasms coexist. To postpone it too long, till the lungs become gorged with blood, and, consequently, disposed to inflammatory action, and the powers of the patient are depressed, is a timid and certainly unsuccessful practice. In the opinion of many good Surgeons, I know it is thought desirable to postpone operative interference as long as possible—"to watch and wait." In this I do not agree. When laryngeal spasms exist with mechanical obstruction, nothing but opening the windpipe places the patient in safety. Out of nine cases consecutively treated by tracheotomy five recovered. The statistics, however, of my colleague, Mr. Durham, are less favorable, thirty-five out of fifty-one cases terminating fatally.

Statistics of operations in these cases.

In some instances the scarification or puncturing of the œdematous opening of the larynx and epiglottis gives great relief. I have been accustomed to do this by means of an ordinary tenaculum or mounted needle. Mr. Tudor, formerly of the Dreadnought, has invented a useful instrument for the purpose, called an

On the epiglottome.

epiglottome. The punctures into the œdematous tissue may be free, and never seem to do harm. Drs. Wallace and Bevan, of Dublin, have spoken very strongly in favour of the calomel treatment, two or three grains being given every hour until the symptoms are relieved; and Dr. Croly uses innuction at the same time. Other Surgeons speak well of antimony, and, doubtless, it is a drug that should always be given in doses of one, two, or three minims of the antimonial wine every quarter of an hour, until some effect has been made upon the disease, and then at longer intervals. The best local application to the larynx is the hot sponge. A blister over the upper part of the sternum sometimes does good, and, in exceptional cases, leeches to the larynx may be used. The time required by all these remedies to produce their effects is too long, and their action is too uncertain to allow the Surgeon to depend upon them in acute cases; as accessories to the treatment they are of use, but as means of preventing death when obstruction exists and spasms are frequent, they are not to be relied upon. When an operation is performed it should be tracheotomy. Laryngotomy is inapplicable, and too near to the disease. Anæsthetics may be given without fear.

Calomel.

Antimony.

Local application.

Diseases of the Larynx requiring Tracheotomy.

Since the introduction of the laryngoscope our knowledge of the disease of the larynx has so much increased, and the treatment of its different affections so much improved, that the subject has become somewhat extensive; so extensive, indeed, that enterprising members of our profession have contrived to turn it into a speciality. This is a subject of regret in a certain sense, as it tends to make the bulk of the profession, and with it the student, look upon laryngeal affections as difficult subjects of investigation, and beyond the reach of average skill. This is not, however, in any way correct, for the use of the laryngoscope or throat speculum is no more difficult than that of any other instrument. To use it neatly and efficiently requires skill and some practice, but the same efforts are also essential to every other surgical investigation.

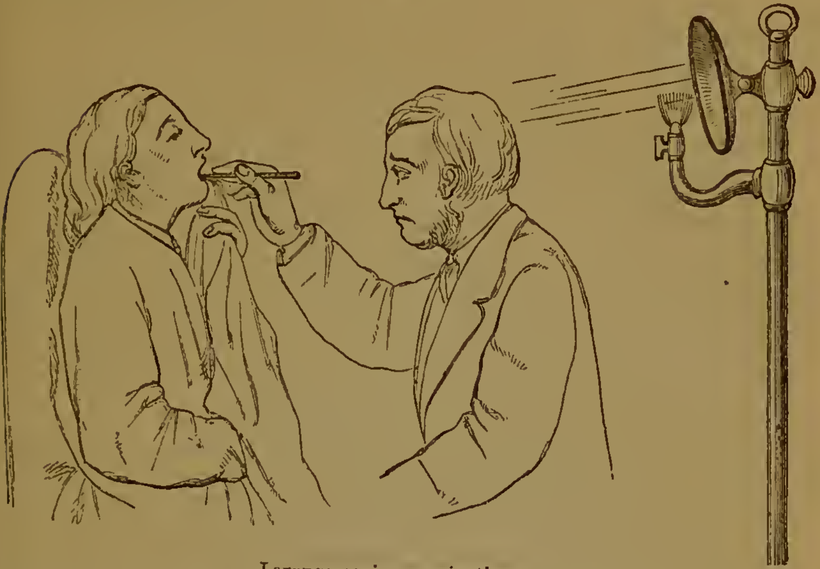
On the laryngoscope.

The first laryngoscope was introduced to the profession in 1829 by the late Dr. B. G. Babington of Guy's Hospital, who, under the term "glottiscope," invented an instrument composed of a mirror fixed to a wire handle, which, being fixed against the palate whilst the tongue was depressed, enabled him to view the upper part of the larynx. Garcia, the singer, in 1855, gave an impulse to the idea by throwing the sun's rays into the back of his mouth by means of a mirror held in his left hand; and so from a dentist's reflector introduced into his mouth he could witness the movements of his larynx in the looking-glass. But to Drs. Czermak and Turck are unquestionably due the credit of having applied this mode of investigation in a scientific way to the diagnosis of laryngeal disease. They employed, however, artificial illumination instead of solar, adopting the practice of Helmholtz in ophthalmoscopic operations.

Mode of use.

The ordinary mode of application of the instrument is very simple. The patient sits with his back to a good light—that of the sun is the best, but a moderator, gas, or electric lamp will suffice. The lamp should be in a line with the patient's face, and on his right side; the Surgeon, with the mirror fastened round his head, faces the light and reflects it on the patient. The patient is then directed to open his mouth protrude his tongue, and hold it with a handkerchief: a warmed mirror is then introduced to the back of the fauces, while the tongue at this time is depressed. The rays of light from the frontal mirror are then made to fall upon the mirror in the pharynx, and, with a little arrangement, the glottis and all the parts around, above or below, may be carefully examined.

Fig. 313.



Laryngoscopic examination.

The pharyngeal mirror may also be well illuminated by simply projecting the rays of light from a large reflector fastened behind a gas or moderator lamp, as seen in Fig. 313.

I have employed this method for many years, and found it more effectual than any other.

It is impossible in the following chapter to give a full description of all the different affections to which the larynx is liable, nor would it be consistent with the object I have in view, since laryngeal affections come as much under the notice of the physician as the Surgeon, and the latter is only consulted when medicine has failed to relieve symptoms, and evidence exists of some progressive affection which, by causing obstruction to the respiratory process, threatens life. In the following chapter I propose, therefore, to consider the diseases of the larynx in their surgical aspect only, and to view them simply in their relation to tracheotomy or other operative interference.

Diseases of larynx in relation to tracheotomy.

In a general way it may be asserted that tracheotomy may be called for under any circumstances in which obstruction exists to the respiratory act; such as in pharyngeal affections mechanically affecting the larynx; in laryngeal disease, acute or chronic, inflammatory or otherwise; or in tumours pressing from without upon the windpipe in some part of its course. It may also be possibly required for some temporary purpose connected with operative surgery, to insure the maintenance of the respiratory act during the removal of a large pharyngeal or maxillary tumour.

Abscess of pharynx.

Pharyngeal Affections Obstructing the Respiration.

Inflammatory affection of throat.

Abscesses about the pharynx or tonsils at times cause laryngeal obstruction, and such a complication should be treated by puncturing the abscess with a guarded bistoury. Inflammatory and ulcerating affections of the throat, more particularly those called diphtheritic, are apt to spread to the larynx and set up a laryngitis.

Tumours of pharynx.

Tumours of the pharynx or tonsils are occasionally met with pressing upon the larynx and interfering with its functions; a cyst may develop at the back of the tongue in front of the epiglottis, and, by its size, almost close the laryngeal orifice; or a naso-pharyngeal tumour may so press downwards as not only to threaten life by suffocation, but to cause death. In a large naso-pharyngeal tumour I had to treat, the former condition was met with, but relief was given by the removal of the growth. In another case, one of cancerous tumour of the pharynx above the soft palate, occurring in a boy, æt. 18, and which rapidly recurred after its removal, death ensued from suffocation, tracheotomy having been rejected. Suffocation from simple enlargement of the tonsils I believe to be unknown, although it has occurred from cancerous disease.

Affections of the Larynx requiring Tracheotomy.

Tracheotomy in acute laryngitis.

In croup.

Inflammatory affections can never exist long without causing some closure of the glottis, thereby endangering life. In acute laryngitis of catarrhal origin, in membranous, and in diphtheritic croup, a few hours may be sufficient to produce this effect, either from œdema of the larynx, suppuration of the larynx, or the effusion of a false membrane. In all, the result is the same, mechanical closure of the glottis complicated with spasm; and in all, the important question presents itself as to whether medical treatment can be sufficient to check the disease, or surgical aid in the way of operative interfence is required. Trousseau, our great authority in this matter of tracheotomy in croup, maintained strongly, that the earlier the operation is performed the greater are the chances of success; that it ought to be performed before death is imminent; and that to whatever degree asphyxia may have proceeded, it ought to be tried; for in the most desperate cases there is a chance of success, provided the local lesion, the croup, constitutes the chief danger of the disease. In these views I entirely concur; they are physiologically sound and clinically correct. Indeed, the operation should be performed in all cases when the disease is steadily progressing and is unaffected by medical treatment, and it should be undertaken *before* asphyxia, carbonæmia, or severe blood poisoning has taken place. To operate before any evidence of deficient oxygenation of the blood, as shown by lividity of the lips, &c., exists would be bad practice, and to postpone operative interference when such lividity is present is to throw away a chance. With retraction of the epigastrium and intercostal spaces, and supraclavicular depression in inspiration, with or without cyanosis, any delay would be dangerous. It is a clinical fact that in a large number of cases the extension of disease is arrested by the operation, though when the lungs have become gorged with blood unfit for circulation by too protracted delay in operating, a successful issue can hardly be looked for.

Tracheotomy in chronic laryngitis.

In chronic laryngitis, whether tubercular, syphilitic, or otherwise, tracheotomy may be required to prevent impending death or as a means of cure. For the first indication it should not be postponed too long, for "too long" often means "too late," some spasmodic attack carrying off the patient. When these attacks consequently appear and recur, tracheotomy should be performed.

Tracheotomy as a means of cure.

Tracheotomy as a means of cure in chronic inflammatory laryngeal affections is not sufficiently practised. "It has been hitherto generally performed in the class of cases to which I have just alluded—to rescue patients from the danger of impending suffocation, and to prolong life when threatened from laryngeal disease; and yet it must have struck most men, when watching cases which have been operated upon under these circumstances, how rapidly all laryngeal symptoms disappear and ulcerative action undergoes a reparative process, both in the pharynx and larynx, after a new passage has been obtained for the respiratory act, and complete quiescence of the parts has been secured by means of tracheotomy." I have a strong opinion, therefore, that it would be wise to perform the operation in ulcerative laryngeal affections at an earlier period than has hitherto been practised, with a view of arresting the progress of the disease, and probably of saving the larynx as a respiratory and vocal organ, anticipating the time when the operation may be demanded for the purpose of preventing impending suffocation. In the first volume of the 'Clinical Society's Transactions' I published some cases illustrative of these views, and my more recent experience has confirmed them. It should not be performed in the very early period of the disease, whilst any reasonable hope exists that by medical or local treatment a successful result may be secured; but it should be undertaken in all cases of progressive disease, when local and general treatment have failed to make any impression on the local affection.

Early operation advised.

Tumours of the larynx.

Tumours of the larynx are not very uncommon. Children are liable to suffer from warty growths of the rima or the surrounding parts, and in adults epithelial tumours are likewise met with. Cancerous growths, involving the larynx, are also on record. Mr. Holmes, in his admirable work 'On Children's Diseases,' informs us that out of twenty-eight cases of tumour of the larynx, which he tabulated from the 'Transactions of the Pathological Society,' seven were cancerous. He also points out the fact that, in cases of tumours of this region, life is threatened by the occasional fits of spasmodic dyspnœa, the patient being often well in the intervals, and, when these recur very severely, it becomes necessary to perform tracheotomy.

When warty growths exist, and it is impossible to remove them from above by means of the forceps, or snare, aided by the laryngoscope, the larynx may be laid open fearlessly in the middle line and the tumour removed. I did this in 1871, in a child, æt. 3, for extensive warty disease of the epiglottis and glottis with complete success; and my colleagues Mr. Durham and Mr. Davies Colley have done the same. I have also, by the operation of tracheotomy, prolonged for many months the life of a man who had a cancerous laryngeal tumour obstructing respiration.

Tracheotomy may also be required for tumours of the neck pressing upon the larynx. I have been called upon to operate under these circumstances on three occasions. It may likewise be demanded for intrathoracic tumours, aneurismal or otherwise, on account of sudden laryngeal spasm, due either to pressure on the recurrent laryngeal nerve, or to compression of the trachea, Dr. Bristowe having well shown ('St. Thomas's Hosp. Rep.,' vol. iii, 1872) "that destruction of the functional activity of one recurrent laryngeal nerve is marked by paralysis of the corresponding vocal cord, which can be recognised by means of the laryngoscope, by impairment of the musical quality of the voice, and (probably) by some difficulty of swallowing, owing to the tendency of food to slip into the larynx, but is not necessarily attended with stridor or dyspnœa; and, in the second place, that compression of the trachea involves stridor and difficulty of breathing which is often paroxysmal and liable to end in sudden death, but that it does not of itself interfere with perfect intonation, excepting only in so far as it may render the voice weak by diminishing the supply of wind to the vocal organs."

Excision of the Larynx.

This operation was first performed by P. H. Watson in 1866, and later by Billroth, of Vienna, in 1873, for cancerous disease; Heine, of Prague; Moriz Schmidt, of Frankfort-on-the-Maine; Langenbeck, of Berlin; Caselli, of Milan, and Gussenbauer, of Prague, but the success that has attended it is not such as to lead me to recommend the operation. The operation can be performed by making a transverse incision parallel to and above the hyoid bone, and a vertical one at a right angle to it over the larynx, the dissection of the larynx being made from above. Dr. Foulis, of Glasgow, has, however, performed this operation upon a man, æt. 28, for recurrent papillary sarcoma, with success. In the operation he left the epiglottis. ('Lancet,' 1877, vol. ii, and 1878, vol. i.)

Bronchotomy, Tracheotomy, Laryngotomy.

Mode of opening the windpipe.

Any opening made by the Surgeon into the windpipe is called "*bronchotomy*;" when between the thyroid and cricoid cartilages, it is called "*laryngotomy*;" when below the cricoid into the trachea, "*tracheotomy*;" and when the incision includes the cricoid cartilage and upper rings of the trachea, it is called *laryngo-tracheotomy*. In all these operations the objects are the same, either to admit air into the lungs when some obstruction exists in or above the larynx, or to facilitate the removal of a foreign body or morbid growth. Dismissing the general term "bronchotomy" from our consideration, the two latter operations claim our notice, and are applicable in two different classes of cases. When the cause of obstruction is *above* the larynx, laryngotomy may be performed; when *in* the larynx, tracheotomy or laryngo-tracheotomy should always be preferred. For the removal of a foreign body or new growth, tracheotomy is the better operation, the incision at times being extended upwards into the larynx, either through the cricoid and thyroid cartilages or downwards as far as needed. For both operations anæsthetics may be safely administered, unless asphyxia be profound, when it is not required.

Objects of the operation.

Laryngotomy.

Cases applicable.

Laryngotomy is not an operation to be performed on children, the crico-thyroid space at an early period of life being too small to allow of a free opening being made into it. It is only applicable in adults when obstruction to respiration exists above the rima glottidis, such as that caused by an impacted mass of food or some pharyngeal growth.

For tetanus or any other spasmodic affection of the larynx threatening life, it may likewise be employed, as well as in operations on the palate, pharynx, &c., in which it is advisable to ensure the free passage of air into the lungs during manipulation; although under these latter circumstances tracheotomy and the use of Dr. Trendelenburg's plug is to be preferred (Fig. 205, vol. i).

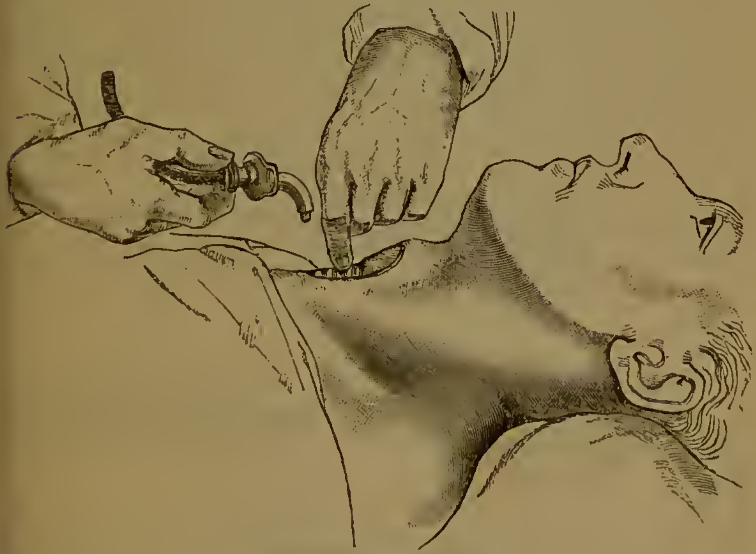
Mode of performance.

To perform the operation the patient should be placed on the back, with the thorax raised, shoulders drawn down, and head extended. The operator should stand on the patient's right side, and feel for the thyroid cartilage, at the lower border of which the windpipe is to be opened. To do this, a vertical incision is to be made in the median line, about one inch long, cutting through all the tissues covering in the crico-thyroid membrane. The membrane should then be opened transversely with a knife. The crico-thyroid arteries cross this space, and may possibly be divided, giving rise to some little hæmorrhage. Sir W. Fergusson has recorded a case narrated to him by Professor Turner, of Edinburgh, in which a fatal hæmorrhage occurred from these vessels. Such a danger is, however, very remote.

On tracheotomy.

Tracheotomy is by no means a simple operation, but under all circumstances is delicate, requiring coolness and caution, and when performed hurriedly is too often made difficult, and even dangerous. In very young children it is always troublesome. The Surgeon may at times be called upon to be rapid in his movements, but never should be hurried. As the result of hurry many are the mistakes that might be enumerated, such as wounding of the innominate or carotid artery; the opening of the œsophagus through the trachea; the puncturing of the spine through both these tubes, &c.

FIG. 314.



Operation of tracheotomy.

Mode of its performance.

The patient should be placed as in laryngotomy, while the Surgeon stands on the right side. The different points in the neck must then

Left index-finger the guide.

be made out, and the existence of any large vein in the line of incision looked for, and, if present, avoided. The best position for opening the trachea is half an inch below the cricoid cartilage or below the isthmus of the thyroid gland; but this is not a point of so much importance as some Surgeons would lead us to suppose. In infants it may be disregarded. An incision about two inches long may then be made through all the soft parts covering the trachea. This may be done rapidly when needed, deliberately when possible, care being taken at the same time, by means of retractors, not to displace the parts. During this step of the operation the Surgeon's left index finger should be his guide; and it should be steadily kept over the trachea till the rings are felt, while it will also intimate the presence of any arteries near the tube or in the line of incision. The rings once recognised, the trachea may be opened with the knife, its edge being turned upwards, and the opening made parallel with the nail of the left index-finger, which is in the wound. When the windpipe has been opened, air, blood, and mucus will at once bubble up. The canula with its pilot should then be introduced into the trachea through the opening which the left index-finger has covered, this finger acting all through as a guide and director, and, lastly, as a plug to the wound till the canula has been introduced. The eye of the operator should be directed to the end of his left index-finger.

Use of hook.

In opening the trachea, some prefer to use the hook to draw it forward, and in cases in which much bleeding exists, or the trachea is very deep, it may be employed. I have, however, rarely used it, having more confidence in the use of the left index-finger as a guide throughout.

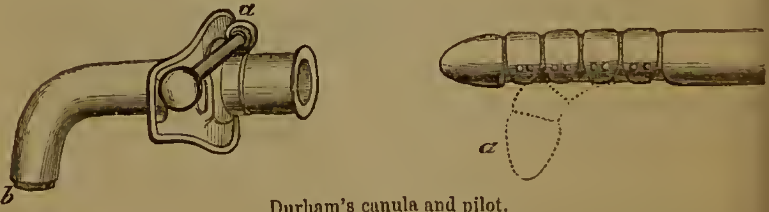
Use of dilators.

Sharp trocars dangerous.

Use of canula.

Some employ also a dilator to keep the wound open till the tube is introduced, while others prefer to open the trachea with a sharp trocar. The former practice is unnecessary, and the latter dangerous, as a sharp trocar may perforate the trachea altogether, and enter the œsophagus, an accident I have known to occur, or if it slip by the side of the windpipe the large vessels will be endangered. With respect to the canula, Fuller's bivalve has hitherto met with general approval, and Durham's "lobster-tail" canula (Fig. 315) has been much liked; though the best by far is the ball-and-socket instrument (Fig. 316) I had made some years ago—its great advantage consisting in the mobility of the tube with the trachea, the neck plate being fixed.

FIG. 315.



Durham's canula and pilot.

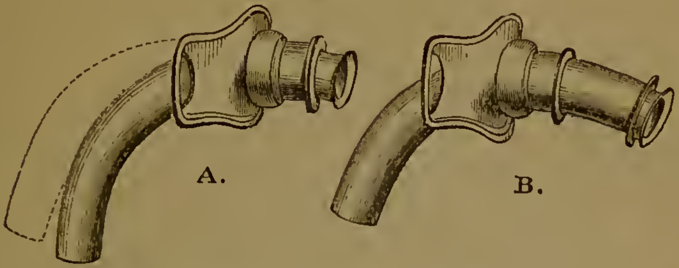
Aluminium canula.

When this canula is made of aluminium great advantages are gained, an aluminium instrument weighing only 60 grains, when a silver one weighs 260. Indeed the aluminium is lighter by 10 grains than the vulcanite. The rigid tube when required to be worn for long, too often excites ulceration by the pressure of its free end on the trachea, which may extend into the innominate artery. Mr. Morant Baker has recently introduced into practice a tube made of vulcanised red india rubber, which seems to answer well, and may be employed on the second or third day after the operation has been performed. Every metal canula should be double, and every canula fixed in position by a piece of silk or tape passed through the shield and fastened round the nape of the neck. After the operation, the atmosphere of the room should be kept warm and moist by the admission of steam, care being taken that the air is not saturated with vapour. The wound ought to be kept clean; strapping and sutures are rarely required; water dressing or sweet oil is probably the best local application. Great care should be observed to keep the orifice of the canula free from mucus and the inner tube clean. A "sucker," Fig. 316A, composed of a rubber bottle, glass tube and rubber spout small enough to enter the canula and long enough to pass down the trachea if required being always at hand for the purpose. This instrument does away with the nasty and dangerous practice of sucking by the mouth. After the operation a piece of muslin should be placed over the tube to prevent the entrance of foreign bodies.

After-treatment.

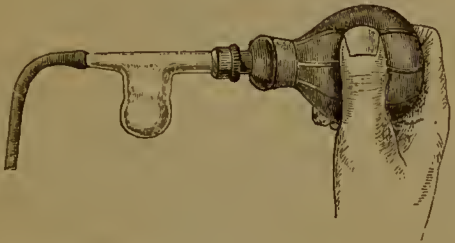
Tracheal aspirator.

FIG. 316.



Bryant's canula. A. Full length. B. Shortened.

FIG. 316A.



Tracheal aspirator for the removal of mucus, lymph, or possibly a foreign body from the air-passages.

Complications.—If the operation should be complicated by hæmorrhage the Surgeon must not be alarmed. When arterial, it must be arrested before the trachea is opened, either by the application of a ligature or by torsion; if venous the sooner the trachea is opened the better, for a few good inspirations do more to relieve the venous congestion, which is almost always present when tracheotomy is demanded,

Complications.

than any other attempt to check bleeding. As soon as the tube has been introduced, the patient may be rolled over on his side, to allow the blood to run away from the tracheal wound. A piece of sponge applied with some pressure over the wound is generally enough to arrest all venous bleeding, unless some large venous trunk has been opened. I have never known hæmorrhage of this kind to be so copious as to interfere with the operation, or to be so persistent as not to cease readily on its completion. If the Surgeon stops his operation till bleeding has ceased, he will too often wait till the necessity of the operation with the life of his patient has passed away.

On opening the trachea in infants.

Opening of the Trachea.—There can be little doubt, that in patients after puberty, the trachea should generally be opened below the isthmus of the thyroid gland, but in infants and young children where the trachea is deeply placed and the neck fat and short, the nearer the opening is to the cricoid cartilage the better. For several years I have been in the habit of opening the trachea immediately below the cricoid ring, and never have hesitated to divide the latter when more room is required. In many instances, I have gone through the isthmus of the thyroid, and never had any reason to regret it; nay, I am almost tempted to believe that the dangers of its division are really theoretical and practically may be disregarded. Of this I am convinced, that the nearer the tracheal opening is to the lower border of the cricoid ring, the better is the operation. If the opening be too small at the first puncture, a second should be made rather than grope about with retractors and instruments to find the original opening. The tracheal tube need not be very large, for Mr. Marsh has demonstrated ('St. Barth. Hosp. Report,' vol. iii) that the rima glottidis is the smallest part of the air-tube. In dividing the soft tissues and fascia on the trachea care should be taken to do so freely to guard against the mediastinal emphysema which Dr. Champneys has shown to be such a common cause of death after tracheotomy ('Med.-Chir. Trans.,' 1882 and 1883), from the escape of air beneath the deep cervical fascia.

Size of tube.

Artificial respiration.

Under all circumstances, the operation should be completed, and even in apparently hopeless cases, artificial respiration should be kept up through the wound. Mr. Holmes has recorded a case of Mr. Tatum's in which it was maintained for two hours with ultimate success.

When tracheotomy has been performed for thyroidal tumours pressing upon the trachea, the Surgeon should have at hand a long perforated tube, small enough to be introduced through the canula, as the tumour may so overlap the trachea as to cause obstruction below the point at which the operation is performed. For the want of such an instrument, I lost a patient whom I saw with Sir Risdon Bennett, while by its aid, I was enabled to save another for several days, the elastic tube being pressed through the canula, past the obstruction, into the lungs. I have had such a tube adapted to my canula as a pilot to introduce it.

Removal of the canula.

It is almost needless to say, that the canula should be removed from the trachea as soon as respiration has been re-established by the natural passage, and that it should on no account be left in more than three months. When required longer, a new one should be substituted, since the canula rapidly undergoes oxidization in the trachea and becomes liable to break. In a patient of my own, where the tube had been worn six months, half its circumference close to the neck shield had been destroyed, and the slightest violence would have broken the instrument in the trachea. The vulcanite and probably the aluminium canula is good for constant use.

Causes of non-re-establishment of respiration.

Mr. T. Smith, in an excellent paper ('Med.-Chir. Trans.' 1865), has given a good summary of the obstacles to the re-establishment of natural respiration after tracheotomy, and he has shown that the chief causes are a narrowing of the passage of the larynx by granulations around the canula, and the impairment or loss of those functions of the muscles of the larynx which regulate the admission of air through the rima. There may, likewise, be a persistence of the original cause which necessitated the performance of the operation, the effects of the original disease, or the closure of the vocal cords from the cicatrization of old ulceration. In three cases now under my observation in which tracheotomy has been performed for chronic ulceration of the larynx, the rima has so contracted as to be impervious in two, and in one, the opening is so small as to be insufficient for respiration, although enough for speaking purposes.

How to judge of the patency of the glottis.

To help the Surgeon to judge of the patency of the glottis, Luer has invented a bullet valve to be adapted to the orifice of the canula; and Mr. T. Smith an india-rubber one which seems equally efficient, and is a simpler instrument. Either may be employed, as anything that helps to decide when the canula may be removed with safety is of value.

CHAPTER XIX.

SURGERY OF THE CHEST.

Contusions.

Contusion.

The chest is liable to be contused, and severe contusions are not unfrequently followed by extensive effusions of blood. The swelling under these circumstances occurs suddenly after the injury, and appears with the discoloration of a bruise. These cases, as a rule, do well if left alone, the extravasated blood becoming absorbed, but, in exceptional examples, the blood may break down and give rise to suppuration.

Treatment.

Treatment.—When the contusion is slight, the application of a cold lead lotion is all that is necessary, and in more severe examples, where extravasation is great, there is nothing equal to the application of cold, either in the form of the metallic tube (Fig. 8½), or of ice. In obstinate cases the use of some stimulating liniment hastens recovery, and the administration of tonics is always of value.

When the effused blood breaks down, and suppuration ensues, the abscess must be opened, but the Surgeon need be in no hurry to conclude that the effused blood is incapable of being absorbed, nor that pus has formed, since it is a familiar fact that blood may remain fluid in the tissues for a long period, and yet be eventually removed by absorption.

Rupture of the Pectoral Muscle

Ruptured muscles.

is an accident which may take place from a forcible strain applied to the muscle when unprepared for action, or from external violence. I have seen a case in which the muscle, from the forcible drawing back of the arm, was nearly torn across about its centre, in which the fingers could be inserted between the divided ends of the torn muscle, and there was much effusion of blood. In that case the arm was bound to the side by a bandage, and ice locally applied, and, three months subsequently, some power existed in the muscle. The amount of repair which is to be expected in these cases depends upon the severity of the injury, and the care with which the parts are kept in position during its progress. As a general rule, the two ends of the divided muscle should be kept in contact for at least two months before movement is allowed. This accident is not rare in children from forcible dragging of the arm.

Fractured Ribs

On fractured ribs.

form about a tenth part of the cases of fracture admitted into a large hospital. This accident is less common in children and young adults than in subjects past middle age, on account of the elasticity of the ribs. In the aged the ribs become so brittle that they break under slight external violence, and in rare cases from the violence of a cough. I have seen this occur in two patients between sixty and seventy years of age, the one a male and the other a female; in neither were there any signs of disease, and both of the persons are now alive.

In lunatic asylums.

Fractured ribs are not uncommon accidents in lunatic asylums, and generally arise from direct violence, though it would be wrong to assume that they are always the result of ill-treatment, as patients when much excited, will inflict unconsciously most serious injuries on themselves, and it has been proved that the bones of many of the insane are in an abnormally brittle state. This is especially true in the disease known as "general paralysis of the insane." Dr. Campbell Brown, of Liverpool, has analysed the ribs of general paralytics, and states that "the ratio of organic constituents to earthy matters is much greater, while the ratio of lime to phosphoric acid is distinctly less in the ribs of paralytics than in those of healthy adults. There are the same differences between the composition of healthy ribs and those of paralytics as between the composition of the adult large bones and those of the fœtus. And generally the composition in cases of paralysis approaches that observed in cases of osteo-malacia." Some striking cases bearing on this subject are recorded by Dr. Hearder in the 'Journ. of Mental Sci.' for 1871.

Causes—direct and indirect.

In the majority of cases, the injury being the result of *direct* violence, the fracture takes place at the part struck, and so the ribs are often driven in. In the minority, where it is due to *indirect* violence such as that caused by a crush or squeeze, the ribs generally give way about their middle, and three or more become injured, both sides being not unfrequently involved. When the bones are merely broken it is called a *simple* fracture; but when complicated with a wound communicating with the fracture, *compound*. When the ends of the broken ribs are driven inwards, the pleura costalis or the lung itself may be torn, and the heart or pericardium or abdominal viscera injured. In an analysis of 136 consecutive cases, which I made when registrar at Guy's, 108 were uncomplicated and of these eight only had secondary inflammation; 28 were complicated fractures, of these six died at once from fatal collapse, sixteen were complicated with emphysema, three with emphysema and hæmoptysis, and three with extensive injury to the lung and secondary inflammatory symptoms. Two of

Varieties.

Complications.

these cases subsequently died from old-standing disease. Fractured ribs on the right side are often complicated with laceration of the liver.

When a rib is broken, the serous lining of the chest, the pleura costalis, is probably injured, and the danger of the accident lies in the secondary inflammation—pleuritis—which may follow; and this occurred in eight of the 108 cases just alluded to. In a case recently seen, which proved fatal from other causes, the pleura was unimpaired, but a quantity of blood was effused into the soft parts outside the pleura from laceration of an intercostal artery. When the lung is injured, as indicated by emphysema or hæmoptysis, pneumonia, which happens in about seven out of every twenty-two cases, is the danger to be feared. Cases that die from fatal collapse *after* the accident generally do so from hæmorrhage due to extensive laceration of the thoracic or abdominal viscera. In gunshot fractures a portion of the ribs may be detached and driven into the lung.

Prognosis of fractured ribs.

In the old and asthmatic.

Simple fracture is a serious accident only in subjects who are the victims of some chronic chest affection, when, from the broken ribs the patients are unable to expectorate, and asphyxia is favoured.

Dangers of complicated fracture.

Fractures complicated with injury to the lung are, however, more serious. When severe, they are *directly* dangerous from the shock to the system and the hæmorrhage that frequently attends them; and *indirectly* so from the fact that the slightest lung wound is liable to be followed by inflammation of the lung itself or of the pleura.

Period required for repair.

Fractured ribs generally unite in about a month; and where they have not been kept quiet, considerable callus may be thrown out, or a false joint formed.

Diagnosis.

Diagnosis.—Pain at the seat of injury, aggravated by sternal pressure, and associated with a peculiar catch in the breath of the patient and the general avoidance of anything like a full inspiration, are somewhat characteristic symptoms of a fractured rib, more especially when they show themselves at once after direct or indirect violence. At times, too, the patient will complain of a grating in the part, and, on the application of the hand over the seat of injury, if the patient be made to cough, crepitus will be felt—this crepitus being caused by the friction of the ends of the broken bone. When the seat of fracture is beneath a thick layer of muscles or fat, this symptom may, however, escape detection; nor should it be too closely sought after when others indicate the nature of the injury, as the manipulation required to elicit this sign is sometimes considerable, and any approach to violence or over-manipulation is always injurious.

Crepitus.

Emphysema.

When emphysema complicates the case, as indicated by a more or less diffused puffy swelling which crackles on pressure, there will be no doubt as to the lung having been injured, since this symptom is caused by the escape of air from the lung into the cellular tissue about the seat of fracture. This may be either local or general; when associated with *hæmoptysis*, it is fair to infer that the lung has been penetrated; the severity of the mischief being gauged by the extent of the emphysema and the amount of the hæmoptysis.

Hæmoptysis.

In rare cases the emphysema lasts for days. In a case under care in October, 1881, it remained for seventeen days after the accident; the patient recovered.

Emphysema without fracture.

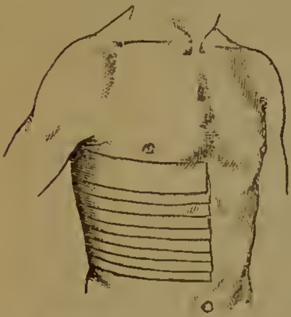
Emphysema may be met with as the result of chest injury without fracture of the ribs, as evidenced by the case of a boy, æt. 5, who having had the wheel of a cart pass across his shoulders, was admitted in 1883, within a few minutes after the accident, into my ward at Guy's with universal emphysema, and such difficulty of respiration that death appeared imminent. The boy's body and neck appeared like a tight sausage. To let out the air I punctured the integuments over the child's body with a small knife an eighth of an inch wide and the air whistled out of the openings with enough force to blow out a lighted wax taper. The relief afforded by the operation was marked, for the child steadily went on to a complete recovery. There was no hæmoptysis in this case or evidence of fracture of the ribs. The child also cried naturally, the fact fairly proving that neither the larynx nor trachea were lacerated. Yet the opening into the air passages must have been very free to give rise to such rapid and general emphysema. The relief given by the operation of puncturing the skin is a point to remember (Brit. Med. Journ., Jan. 26, 1884).

Treatment.

Strapping.

Treatment.—The object of the Surgeon in the treatment of a simple fracture of the thorax is, to maintain the ribs at rest, which should be effected by the application of strips of strong adhesive plaster two inches broad, extending from the sternum to the spine, and from at least three inches above to three inches below the seat of injury.

Fig. 317.



Strapping in fracture of ribs.

How to be applied.

Bandage.

The strips should be applied from below upwards and at the end of expiration, and each one should be made to cover half of that which preceded it (Fig. 317). By this method, the movements of the broken ribs are restrained without those of the opposite side being interfered with. It is, moreover, both in comfort and efficiency, far superior to the old method of encircling the chest with a flannel roller; indeed, it generally affords speedy relief to all symptoms. When the case is complicated with emphysema or even hæmoptysis the same treatment should be carried out, for in these more severe cases the necessity of maintaining the immobility of the ribs is just as necessary as in the less severe.

Gutta-percha mould.

In rare cases in which much displacement has occurred, a sheet of felt or gutta percha made soft by hot water and moulded to the part is of great value, the mould being subsequently fixed by strapping as described.

Rest.

Sedatives.

Antimony.

The patient should be kept quiet, though not necessarily in bed, and abundance of bland, nutritious, but unstimulating food given, with sedatives, if required; of the latter chloral in half-drachm doses is probably the best, though morphia or Dover's powder are also good. When cough or any symptoms of inflammation of the pleura or lungs appear, antimonial wine in doses of thirty minims for an adult every four or six hours, in some saline mixture, is a most valuable remedy. When chest complications are severe, and orthopnœa with a sense of suffocation from pulmonary congestion threatens life, venesection should be practised. Local treatment by itself was sufficient in 100 of the 136 cases above mentioned.

Venesection.

In a case of severe injury to the chest that came under my care some time ago, caused by the passage over it of the wheels of a heavily laden cart, fracture of five or six ribs and dislocation of the clavicle occurred, associated with collapse, intense dyspnœa, and hæmoptysis; I bled the patient twice in twelve hours, and each time with immediate relief, the case going on to a good recovery. In it the severe dyspnœa and venous congestion, the rapid and hard pulse that came on as soon as the collapse of the accident had passed away and the circulation had been restored, too surely pointed to an excessive engorgement of the lungs, and indicated that if relief were not afforded, absolute suffocation would speedily ensue by the patient's own highly carbonised blood. At such a crisis, antimony, however beneficial in simpler cases, could not be trusted, as there was no time for it to take effect. Under these circumstances bleeding was performed, and, as the blood flowed, life seemed gradually to return; the laborious breathing became quiet and subdued; the deadened and congested eye, bright and natural; the pulse from being full and hard, softer and less bounding; and the boy's feelings, released from the impression that death was nigh at hand, became more hopeful and resigned; and, as a spectator, I felt such a hope was valid, and that success might crown our efforts. After the lapse of twelve hours, however, the symptoms returned, and the repetition of the bleeding was followed by a repetition of all its benefits. The antimony then came in to complete the cure; by the double venesection, the pulmonary vessels had been relieved of their congestion, while the antimony, in acting upon the circulation, perfected the cure by preventing a return of the former threatening symptoms. The benefits arising from the treatment adopted in this case have such a lasting hold on my memory that I cannot too strongly recommend the practice thus pursued, and the more so, as I have seen it equally successful in other cases.

Care.

Utility of venesection.

Bleeding is now rarely performed; and at Guy's Hospital I believe it is rarer than any capital operation. In the case of lacerated lung, however, when urgent dyspnœa makes its appearance and the powers of the patient do not forbid it, I know of nothing which gives greater relief to the patient or greater satisfaction to the practitioner. Bleed with no sparing hand; letting it flow freely in a full stream, and as it flows, the symptoms will gradually disappear. When relief has been obtained, arrest the flow immediately, as syncope can only do harm. The aim should be to make an impression through the systemic circulation upon the pulmonary. The patient should be carefully watched, and the operation repeated if the symptoms return, and, if necessary, even for a third time. The antimonial treatment, however, must not be neglected. The object of the bleeding is to relieve immediate symptoms and to give time for the antimony to take effect, because when the patient has been brought fully under its influence, all danger may be said to have disappeared; few patients die from secondary inflammation of the lungs when once fairly under the influence of antimony.

Fracture of the sterno-costal cartilages.

Fracture of the sterno-costal cartilages is a rare accident. I have seen but few cases; in one of the seventh rib, which had resulted from a direct blow, a false joint existed. In a recent case, in which the cartilage of the right second rib was driven in by direct violence, no harm followed. These, which are said to unite generally by bone, can be treated in the same way as fractured ribs.

Dislocation and fracture of sternum.

Diagnosis.

Treatment.

Dislocation and fracture of the sternum are likewise rare accidents, and the majority of them are complicated with other injuries, especially of the head and spine—they were found in four out of fifty-six fatal cases of injury to the spine at Guy's Hospital. The sternum yields owing to the violent descent of the chin against the manubrium. Fractured sternum is also occasionally met with as a complication of fractured ribs. When fracture takes place it is generally transverse and oblique from before backwards, the lower fragment being found projecting. Only rare examples exist of a vertical fissure. When the upper portion of bone is displaced, it is generally displaced backwards. Rivington, in an able paper ('Med.-Chir. Trans.,' 1874), has fairly shown that displacement occurs in preference to fracture when an arthrodial joint exists between the manubrium and gladiolus. When deformity is present from displacement of bones, the diagnosis is easy, and when this does not exist, pain in the part, aggravated by a full inspiration and crepitus on the application of the hand, are the chief symptoms. The *treatment* must be the same as for fractured ribs, namely, the recumbent position and strapping over the part, complications being dealt with as they arise. I have lately had under care a man who, from a blow from the pole of a waggon, had the upper two inches of the body of the sternum displaced inwards from the manubrium and costal cartilages; the bones partially recovered their position in three weeks, and the man got well.

Dislocation of ribs.

Dislocation of the ribs requires notice, although little can be said about the subject. It is rarely if ever an accident *per se*, and when it occurs it is part of a more severe injury, such as fracture of the spine, or complicated fracture of the ribs. The same remarks apply to dislocation of the *ribs from the cartilages*, and the *cartilages from the sternum*. Practically all these cases should be dealt with like fractures.

Wounds of chest.

Wounds of the Chest.

Non-penetrating wounds.

The main point to be determined in such cases as these is, whether the wound is superficial or has penetrated the pleura; for if the former obtains, slight cause for anxiety exists, but if the latter, the accident is grave.

Penetrating wounds of chest.

Symptoms.

When the wound is *penetrating*, the extent of the penetration and the organ penetrated has to be determined. Is the pleura alone wounded—a rare injury—or is the lung involved? Is the heart injured, or any of the great vessels—the intercostal or internal mammary artery? Many of these points can only be determined by a knowledge of the kind of weapon employed, its subsequent appearance, the direction of the force, and the anatomical knowledge of the Surgeon; and even then the difficulties of these cases are often great, as witnessed in a recent memorable trial (Flora Davy). When emphysema and hæmoptysis are present they may be accepted as clear indications of a wounded lung. Emphysema alone is always a suspicious symptom, though it may occur to a limited extent in non-penetrating punctured wounds that traverse the soft tissues outside the thorax; while the absence of hæmoptysis is no proof that the lung has escaped injury. When blood and air bubble through the wound and air passes freely from it, or a portion of lung protrudes, there is no room for doubt as to the nature of the injury; but these cases are exceptional. In the majority the diagnosis is ever uncertain, since there are no definite individual symptoms by which injury to the lung is to be diagnosed. The Surgeon, in his anxiety to make out the point, must never be induced to probe the wound, or to explore it with a finger; nor should he test the condition of the lung by making his patient cough to expel air through the thoracic opening. Indeed, he should throw aside all direct or manipulative modes of investigation, and trust to the indirect.

Not to probe wound.

Effects.

The *direct* effects of a penetrating wound are, hæmorrhage into the chest or hæmo-thorax, emphysema, pneumo-thorax, and hernia of the lung. The *secondary* results are those of inflammation, such as pleurisy or pneumonia, hydro-thorax, or empyema, with their consequences.

Prognosis.

The *prognosis* is always unfavorable, and should be guarded, more particularly when the wound is penetrating; but when a week has passed without any unfavorable symptoms appearing, a more promising and decided tone may be assumed.

Treatment.

Treatment.—In all suspected or obvious penetrating chest wounds the utmost gentleness should be employed, and complete quiet enforced; as any deviation from this practice may disturb nature's reparative process, disarrange clot, and excite over-action or inflammation. The external wound should be carefully *cleaned and closed*, and all foreign bodies removed. The patient should be placed in the recumbent position, and on no account allowed to stir. He should be fed on the simplest nutritious food, and for the first two or three days this should be cold; ice and milk is, without doubt, the best mixture. The collapse which often follows the injury need not excite alarm, unless it be protracted or severe, for when the result of hæmorrhage it is not only a salutary measure, but the only means the Surgeon looks to for the arrest of hæmorrhage, as he himself is powerless to interfere. If blood, however, accumulates in the chest, and by its mechanical pressure threaten life, some means must be found for its evacuation, either through the original wound, or by the operation of tapping, or by an incision of the thorax. The indications should be very decided before the Surgeon interferes, as the extravasated blood rapidly coagulates, and consequently is difficult to remove. The same remarks hold good when air accumulates or is pent up in the pleural cavity.

Closure of external wound.

Rest.

Attend to collapse.

Treatment of reaction.

The symptoms that attend reaction should be carefully watched, and anything like excess of action, as indicated by increased difficulty in respiration, cough, or a rapid pulse, ought to be met by the administration of antimony in half-drachm doses of the wine with some saline every three or four hours.

Antimony.

Venesection.

If the lungs become gorged with blood and asphyxia threatens, venesection is as valuable a remedy in these cases as it has been shown to be in those of fractured ribs. Dr. Macleod tells us, that in the Crimea the cases of gunshot wounds of the chest that did the best were those in which early and repeated bleedings were had recourse to. Pain must be relieved by anodynes, chloral being better than opium.

Sedatives.

Hernia of lung.

Hernia of the lung or pneumocele is a rare consequence of a punctured wound of the thorax. I have seen but one example where the tumour was on the left side, external to the nipple, and about the size of a walnut. The mass was left *in situ* and gradually withered. When the hernia is recent, however, and the lung healthy, its reduction is generally considered to be the best practice, but when of long standing and diseased it had better be left alone. Its removal by ligature or the knife has likewise been recommended, successful cases having been recorded of all forms of practice. In a case which came under my care at Guy's in 1876, of fracture of the sternal ends of the left third and fourth ribs, by the man falling upon the blunt end of some wooden palings, in which the bones were driven in without wounding the integuments, a hernia of the lung took place the size of a duck's egg, but an excellent recovery followed the reduction of the hernia and the persistent application of pressure. Velpean has recorded an instance of hernia of the lung following the healing of a wound. The tumour in such a case is covered with integument, and is called the consecutive variety of hernia. In such a case, all that can be done, is to protect the lung from injury, by a shield.

Example.

Lacerated lung without fracture of ribs.

Laceration of the lung without fracture of the ribs is an accident of occasional occurrence, and I have recorded an instance in 'Guy's Reports' for 1860, arising from extreme pressure upon the elastic ribs of a boy æt. 7. I saw another case in 1869, in a child æt. 4, who had been run over. The rent was on the lateral side of the right lung and ran from its apex to base. The ribs of the same side were broken at their angles, far behind the seat of rupture. Poland also, in his excellent article on the chest in 'Holmes's Surgery,' has quoted several others. M. Gosselin's explanation of its cause is probably correct, viz. "that at the time of the injury when the chest sustains the violence, the lungs are suddenly filled and distended with air by a full inspiration, and the air, prevented from escaping by occlusion of the larynx, thus becomes pent up in the lung tissue, and the lung, not being able to recede from the superincumbent pressure, its tissue necessarily gives way." The symptoms of this injury are much the same as have been mentioned in the paragraph on wounds of the lung, while the treatment must be similar.

Compression of the chest.

Severe compression of the chest may likewise cause laceration of the heart or large vessels; also brain symptoms such as unconsciousness, epistaxis, and hæmorrhage into the orbit beneath the conjunctiva and eyelids; and, in a singular case which I recorded in the same volume of the 'Guy's Rep.' as that of the boy just quoted, paralysis of the muscles of deglutition and of the larynx, which lasted for two days.

Abscesses about the chest.

Abscesses are frequently found about the chest, and in rare instances may be due to the discharge through the lung of a foreign body. Thus Dr. Wilks recorded at the Path. Soc. on Nov. 1, 1881, a case of a child in which an ear of corn was discharged from an abscess situated in the left suprascapular region. A recovery followed. No history could be obtained as to how the foreign body entered the lung. It was probably inhaled. When they are situated beneath the pectoral muscles they are very obstinate. They may be confined to the cellular tissue of the part and connected with the subpectoral glands or associated with ruptured muscle or inflammation of the periosteum or bone.

When connected with the muscles, they must be opened and the parts kept quiet by binding the arm to which the muscle belongs to the side, as each movement of the muscle retards recovery.

When due to *periostitis* or *ostitis*, they are frequently syphilitic, and are more commonly situated over the sternum, though any of the ribs may be affected. Under these circumstances, constitutional treatment[1] is essential, and the iodide of potassium in gradually increasing doses from five to ten grains in some tonic, such as bark, is the best medicine. If the bone dies (necrosis) the dead portion must be removed when nature proves herself incompetent to throw off the *sequestrum*.

When sinuses exist about the thorax, the Surgeon should always be alive to the fact that they may be due either to an *empyema* which has naturally discharged itself, or to a *substernal abscess* which is making its way through the intercostal spaces. The history of the case will be found to be the only correct clue to the diagnosis. In both instances, a free opening into the abscess and the washing out of its cavity is required.

Tumours of chest.

Tumours of the chest are not uncommon, but come more under the notice of the physician. Malignant and other tumours, however, may arise external to the ribs, and I have seen several cases of exostosis from the ribs and one of enchondroma. No surgical interference was called for. Exostosis from the first rib may press upon the branches of the brachial plexus and give rise to some pain, or upon the subclavian artery or vein and produce obstruction. In some cases these exostoses have been removed.

Deformities of chest.

Pigeon breast.

Deformities of the chest are mostly due to spinal curvatures, though the contracted or compressed thorax with the projecting sternum of childhood (pigeon breast) is frequently found where some long-continued obstruction to natural respiration exists such as enlarged tonsils. This is not, however, permanent in a large number of cases, since children who are the subjects of it "grow out" of the deformity, as their general condition improves the cause is removed, and their powers strengthen. It is commonly found in rickety subjects, and is without doubt occasionally the result of enlarged tonsils.

Deformity of the chest may be due to an old pleurisy.

Tapping the Chest.

Thoracentesis.

In pneumothorax.

When air accumulates in the chest (*pneumo-thorax*) either as a consequence of disease or accident, causes pressure on the lung and interferes with the respiratory process so as to create alarm, the tapping of the chest (paracentesis thoracis) with a small trocar and canula fitted with a valve, may be called for. When blood accumulates (*hæmo-thorax*) producing similar alarming symptoms, and the blood is mixed with air, and it is clear that life will be extinguished if relief be not afforded, the blood and air must be let out; and for this purpose it is probably the best operation to make an incision into the thorax where no wound previously existed, or to enlarge a small wound when present. To give relief with a trocar and canula is always a difficult and often an impossible task on account of the coagulum. When *serum* presses upon the thoracic contents (*hydro-thorax*) and requires surgical interference, the trocar and canula with the aspirator are beyond doubt the best instrument to employ, great care being observed to exclude air. The object, under all these circumstances, is to remove the pressure from the lung in the most effectual way by the withdrawal of the compressing material.

In hæmothorax.

In hydrothorax.

In empyema.

When pus exists (*empyema*) Surgeons are not quite decided as to the best means to be employed, although all are agreed as to the propriety of drawing it off. A generalised empyema rarely points externally, a localised one does so frequently. For diagnostic purposes the aspirator may be a valuable instrument, as it is for the first emptying of a localised empyema, but for a general empyema the practice of aspirating is not to be advocated, since nothing less than free drainage is likely to succeed as a general rule. To tap by means of the aspirator or the trocar and canula gives temporary relief, but does not cure the disease, for which more efficient measures are required. For my own part I believe that when pus so presses upon the lungs and interferes with the respiratory process as to call for surgical interference, the pus must be let out, by means of a free opening, the opening being large enough to permit of the free escape of all fluid through a drainage-tube. The introduction of drainage-tubes by M. Chassaignac has been of great service in the treatment of empyema. Dr. Goodfellow and Mr. De Morgan, early advocates of their use in this country, passed the perforated india-rubber tube through the canula upon a long iron probe, and brought it out of a second opening in the lower and posterior part of the chest, this second opening being made with a scalpel upon the extremity of the probe pressed against the lower intercostal space. The perforated tube consequently passed as a seton through the chest and allowed the free escape of any fluid in its cavity.

On drainage-tubes.

Their advocates.

Not advised.

I have never adopted this practice in the way here detailed, being satisfied with a free opening into the thorax, either with a scalpel or large trocar and canula, and the introduction of a drainage-tube into the thorax, either through the canula or otherwise, and the subsequent daily washing out of the cavity with a solution of iodine. Sub-aqueous drainage may be employed. In May, 1875, I followed the former practice in the case of a gentleman, æt. 37, whom I saw with Dr. Rowlands, of Carmarthen, and drew off three quarts of pus from his left chest through a free opening, and subsequently passed a drainage-tube into the cavity. In three months convalescence ensued, and in another month he was quite well, the lung on the affected side having expanded. Indeed, I quite coincide with Dr. Goodhart ('Guy's Hosp. Rep.,' 1877), that "if drainage is decided upon nothing short of perfect drainage is safe for the patient;" and to this end the opening into the thorax must be free, and the cavity of the chest kept well emptied, either by irrigation or by what has been described as subaqueous drainage, which should be carried out as follows:—"Having determined on the spot at which puncture of the chest is to be made, a trocar and canula are taken, the bore of which is about five millimètres. A length of several feet of black or red india-rubber tubing, which will slip easily through the canula, is placed ready at hand; the chest is then tapped and the trocar withdrawn, and as the fluid comes in full stream by the canula, the india-rubber tubing is pushed along the latter into the chest as far as necessary—usually four or five inches. The canula is then withdrawn over the tube, leaving the one end of the latter in the chest, while the other or free end is kept under water by the side of the bed. The tube then acts as a syphon."

Sub-aqueous drainage.

This plan of drainage is not, however, very complete, for out of 30 cases in which it was employed, as reported by Dr. Goodhart, in 18 imperfect drainage had to be recorded; and as this is a method which professes to drain away pus, it cannot be said to have proved successful.

In young people, where the ribs are elastic, good results may be looked for; but in the old, where the ribs are rigid, no contraction can be expected.

The Operation.

Mode of performing thoracentesis.

In tapping the chest for air, serum, or pus, the following points should be observed:—Where the signs of disease are most marked, there the puncture should be made. When the chest is full of fluid the eighth or ninth intercostal space should be chosen just in front of the angle, or the seventh midway between the sternum and spine. This latter spot can always readily be found by drawing a line with a string round the body on the level of the nipple, and midway between the sternum and spine this line will cut the proper intercostal space. At this spot, close to the lower rib, a small incision should be made through the skin and fascia with a lancet or scalpel, and through this the trocar and canula, warmed and oiled, should be introduced; the trocar, as soon as it has perforated the chest, should be withdrawn, the canula being pushed more home. When the operation has been performed for air or serum, a small instrument should be employed, and great care used to prevent the admission of air. For this purpose there is no better instrument than the pneumatic aspirator of Dr. Dieulafoy, or one of its modifications, and Dr. Bowditch, of Boston, United States, a staunch supporter of this practice, reports ('Practitioner,' April, 1873) that during twenty-four years, and in 270 operations, he had never seen any injury done by the aspirator. As a substitute, one of the canulas may be used fitted with a stop-cock or valve to prevent the admission of air.

Dieulafoy's aspirator.

When the chest requires opening for the discharge of blood or pus, a free incision or large canula should be resorted to. I prefer an incision, and make it large enough to admit my little finger, and subsequently a large india-rubber drainage-tube. Trousseau strongly advises the operation of tapping when serous effusion fills the cavity, as indicated by auscultation and percussion; when oppression of breathing also exists it may be urgently needed, but this oppression, adds he, is one of the most deceitful of signs, and its absence ought not to inspire too great a feeling of security; as by refraining from interference we run the risk of losing patients, whom the operation would assuredly have saved. In empyema he fixes in the canula, and draws off the fluid every twenty-four hours, injecting the chest with a solution of iodine, one part of the tincture in six, every two, three, or four days.

Trousseau's advice.

It should, however, be recorded that sudden death has taken place after thoracentesis for pleuritic effusion or empyema, although evidence is wanting to prove that any distinct relation exists between the operation and death, since cases are on record in which sudden death ensued in the normal course of cases of pleuritic effusion. Trousseau has recorded examples of the latter kind, and Drs. Cayley and Broadbent of the former ('Clin. Society,' 1877).

Sudden death after tapping.

Apnœa, or so-called Asphyxia.

On asphyxia. Causes.

Death from asphyxia, in the common acceptation of the term, means death from either the cessation of the respiratory process or the want of the ordinary respiratory medium (oxygen), the heart ceasing to act after the cessation of the respiratory process. Etymologically it means an absence of pulse. The more correct term is apnœa. It is caused by whatever interferes with the admission of the air into the lung by such acts as *drowning* or *hanging;* by diseases that mechanically block up the air-passages, or excite spasm of the larynx; by any external or internal condition of the thorax that prevents the admission of air into its cavity or interferes with its expansion; by the want of the respiratory medium, or by the inhalation of toxic vapours.

May be rapid or slow.

Under some circumstances, the asphyxia is rapid or acute, in others, chronic. In accidental cases, it is chiefly the former; in disease, the latter. In both, however, the result is the same, the blood not being decarbonised as it should be, and what Dr. Cleveland has rightly called carbonæmia ensuing. Special symptoms may depend entirely upon the nature of the asphyxiating cause, but the ultimate effects are the same in each. In all, whether slow or rapid, there is congestion and lividity of the face. In all, the heart continues to beat, though laboriously, after respiration has ceased, the action becoming gradually less distinct till it stops altogether. It is possible for the heart to continue its action from two to four minutes after the last respiratory effort.

Condition found after death. Heart and vessels.

After death, it has generally been thought, the *cerebral vessels* would be found gorged with blood. Ackeman has shown, however, that this condition is present only when the head of the subject has been kept lower than the rest of the body, and that death by suffocation is always connected with an exsanguine state of the cerebral vessels. The *right side of the heart and great vessels* will be full of black blood, whilst the *left* side will be found empty, and the whole arterial blood will be, as the venous, of a dark colour. All the abdominal viscera will be engorged with blood.

Lungs.

The *lungs*, in cases of hanging and mechanical obstruction, present no characteristic appearance, but in those of drowning they will be more or less filled with water or the drowning medium, and incapable of collapsing, and will feel heavy and doughy to the touch. The air-tubes, moreover, will be choked with a sanious foam composed of blood, water, mucus, and often foreign matter churned up with the air of the lungs. Frothy water mixed with blood will also pour out of any section of the lung. These points were clearly stated by the Committee of the Roy. Med. and Chir. Society on suspending animation, and recorded in the 'Transactions' for 1862.

Drowning.

On drowning.

How long a human being may be under water, and yet recover, is an important question, but the answer depends upon many considerations. Dr. Sanderson believes he has demonstrated by experiments that in animals the duration of life turns upon the amount of air confined in the chest at the time of immersion; that when the animal on immersion fills its chest with water by an inspiratory effort, death is most rapid; but if the chest be full of air at the time, and no such inspiratory effort takes place, life may be prolonged for several minutes.

The occurrence of syncope at the moment of immersion, whether from fright, shock, or previous injury, is consequently a happy accident, the respiratory act being materially diminished by the syncope. "If a person be completely submerged," writes Dr. W. G. Harley in 'Holmes's System,' "and the entrance of water to, and exit of air from, the lungs not prevented, we believe that recovery would be impossible after two minutes. On the other hand, if the air-passages were closed against the entrance of water, and the chest kept full of air, we see no reason for thinking that a human being would perish either more slowly or more quickly than a dog placed under similar circumstances, namely, in from four to five minutes."

Occurrence of syncope.

Death by *strangulation* is due to asphyxia alone, and, as a rule, is homicidal, being consequently often complicated with other injuries.

Death by *hanging* is of a mixed form; since in addition to the strangulation by the cord, there is the added traction on it by the weight of the falling body.

Hanging causes death, according to Dr. A. Taylor, "commonly from apnœa, but sometimes from apoplexy, caused by pressure on the jugular vein, being preceded by convulsions, often lasting for many minutes, but in all probability not accompanied by more than momentary pain. Occasionally there is found displacement or fracture of the first or second of the vertebræ, with compression of the spinal marrow. This cause of death is only likely to be observed in corpulent or heavy persons, when a long fall is allowed by the cord, and is seldom met with in judicial executions." This latter fact is supported by the observations of Dr. Barker, of Melbourne, who informed Professor Haughton, of Dublin, that in fifty-four post-mortem examinations of criminals hanged according to the old or "short-drop" system, in not a single case was there dislocation or fracture of the neck. In the following plan, however, introduced by Dr. Barker, this dislocation was the rule. Dr. Haughton quotes his words ('Med. Times and Gaz.,' June 21st, 1871):—"I have the knot put about two inches from the spine, so that when it is tightened by the weight of the body the knot comes on the vertebræ; by the fall the body has an impetus forwards, the resistance being at the beam to which the rope is fastened. The knot acts as a fulcrum to push the head forwards. By this arrangement I have found in all cases there was a dislocation and fracture of the cervical spine and pressure on the cord, laceration of the muscles of the larynx, and generally fracture of the hyoid bone, death being always sudden and complete; no long drop is required." To the Irish and American long-drop system there are grave objections. When the cord is crushed, death is instantaneous; when not so injured, life may be prolonged for minutes, usually about three; but there is no evidence to believe that the period may be extended to ten. Conscious life, under both circumstances, probably is soon lost, rarely extending beyond the *three* minutes.

On hanging. Causes of death. Taylor's views.

Effects of short drop. Dr. Barker's experience.

Long drop.

When the cord is not injured, Taylor computes that life may be restored after five minutes of suspension, and Tardieu, an eminent French writer, gives a similar period.

Treatment of Apnœa or Asphyxia.

All obstruction to the passage of fresh air to and from the lungs is to be at once, so far as practicable, removed; all froth and mucus to

Treatment of asphyxia.

Rules.

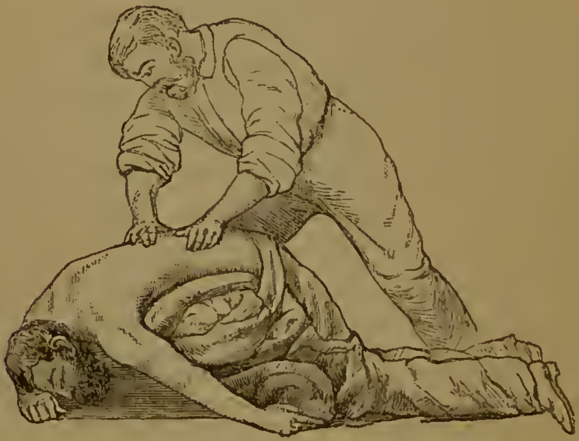
be cleansed from the mouth and nostrils, and all tight articles of clothing to be at once taken away from the neck and chest. In slight cases of temporary apnœa the treatment is as in syncope: dropping the head, which should be low in all cases, a dash of cold, or alternately of cold and hot water to the face, or a smarting slap upon the epigastrium, generally sufficing to revive the patient. When this proves useless, artificial respiration should be instantly commenced.

The methods of artificial respiration which have been successively in use are those of the late Drs. Marshall Hall and Silvester; but I believe the best method to be the one more recently advocated by Dr. Benjamin Howard, of New York. This "direct method," as the author calls it, was first published in the form of a prize essay by the American Medical Association in 1871, and has since been adopted by the United States Government Life Saving Service, the Life Saving Society of New York, &c. It is eminently simple and effective, and is to be applied in the treatment of the drowned as follows, the rules having been drawn up for me by Dr. Howard:

Method.

RULE 1.—FOR EJECTION AND DRAINAGE OF FLUIDS, &C., FROM THE STOMACH AND LUNGS. *Position of Patient.*—Face downwards with forehead resting upon the forearm or wrist, to keep the mouth from the ground, and a hard roll of clothing beneath the epigastrium, which should be the highest point, while the mouth is the lowest (Fig. 318).

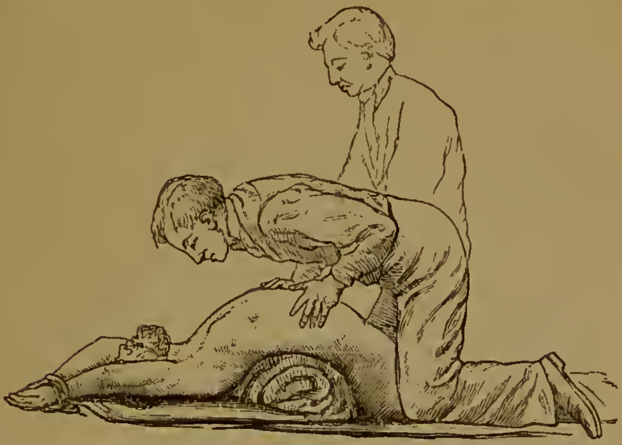
FIG. 318.



Position and Action of Operator.—With the left hand well spread out upon the base of the thorax to the left of the spine, and the right hand upon the spine, a little above the left, and over the lower part of the stomach, the operator should with a forward motion throw upon them all the weight and force the age and sex of the patient will justify, ending this pressure of two or three seconds with a sharp push, which helps to jerk him back to the upright position. And this movement should be repeated two or three times, according to the period of submersion and other indications.

RULE 2.—*Position of Operator.*—In a kneeling posture, astride patient's hips. His hands upon the chest, so that the ball of each thumb and little finger rests upon the inner margin of the free border of the costal cartilages, the tip of each thumb near or upon the zyphoid, and the fingers fitting into the corresponding intercostal spaces. The elbows firmly fixed, making them one with the sides and hips; then—

Fig. 318*a*.



Artificial respiration by direct method.

To Perform Artificial Respiration. *Position of Patient.*—Rip or strip clothing from the waist and neck. Face upwards; shoulders slightly declining over. Hard roll of clothing placed beneath thorax; the head and neck bent back to the utmost, with the hands on the top of the head (one twist of handkerchief around the crossed wrists keeping them there) (Fig. 318*a*).

The Operator pressing upwards and inwards towards the diaphragm, using his knees as a pivot, and throwing his weight slowly forwards two or three seconds, until his face almost touches that of the patient, should end with a sharp push, which helps to jerk him back to the erect kneeling position. He should then rest three seconds, and repeat this bellows-blowing movement as before, continuing it at the rate of seven to ten times a minute, taking the utmost care on the occurrence of a natural gasp gently to aid and deepen it into a long breath until respiration becomes natural. When practicable, the tongue should be held firmly out of one corner of the mouth with the thumb and forefinger armed with dry cotton rag.

Avoid all impatient vertical pushes; the force upward and inward must be increased gradually from zero to the maximum the age, sex, &c., may indicate. Abandon no case as hopeless within an hour's useless effort.

In the application of this method to cases of stillbirth, the child lies along the left hand of the operator, the ball of whose thumb takes the place of the hard roll of clothing seen in Fig. 318*a*. Over this the shoulders decline, the head falling back with the arms, if convenient, on either side the face. The buttock and thighs are supported by the operator's fingers.

Method applied to stillbirth.

Thus the operator has the prominent little thorax completely within the grasp of his right hand with firm counter-pressure behind, enabling him to apply, locate, distribute, direct, or alternate his pressure as he pleases.

Advantages of the direct method.

The advantages Dr. Howard claims for this method over other methods are — 1st. It provides for ejection and drainage of fluids, &c., from the stomach and lungs, and in such a way that each motion for ejection induces an alternate inspiration. 2nd. It excludes the tongue from the pharynx without manipulation. 3rd. It secures elevation of the epiglottis and a post-oral air-way from the glottis to the nares. 4th. It includes a remedy against syncope and cerebral anæmia. 5th. It obtains a more general expansion of the thorax. 6th. It effects a thoracic compression which is more complete, better distributed, directed, and regulated. 7th. It is done by one person, and can be applied instantly on the spot wherever the patient is found. 8th. It is more easily understood by the illiterate, is less fatiguing to the operator, and is free from unnecessary motion or violence.

When respiration is re-established.

When respiration is re-established, maintain the temperature of the body by friction, warm blankets, and when possible by warm water (106° F.), or air bath, keeping the head where a circulation of pure air may be maintained. As soon as the patient can swallow give warm milk, beef tea, tea, or coffee, with a tablespoonful of some spirit, or these may be injected by the stomach-pump. When respiration is restored put the patient into a warm bed, with hot bottles to his feet, and encourage sleep, but let him be watched in case of secondary or relapsing apnœa; at the slightest symptoms of which let friction and even artificial respiration be re-employed. Give volatile stimulants, such as the spiritus ammoniæ aromaticus.

SURGERY OF THE URINO-GENITAL SYSTEM.

CHAPTER XX.

DISEASES OF THE KIDNEY.—STONE.—NEPHROTOMY.

Malformations of the kidney.

Malformations of the kidney have more scientific than surgical interest, yet, they may have an important surgical bearing, for when any accident from external violence or internal irritation happens to a single or imperfect organ, the life of a patient is more likely to be jeopardized than when it is normal. In a case recorded in page 690, vol. i, this fact was illustrated. When a kidney is single, it is usually large, and sometimes has the form of a horseshoe; when it assumes a central position, with the convexity of the curve downwards, it may be regarded as a double organ, the vessels entering from above in their normal way. A kidney may also hold a position nearer the pelvis, or even lie in the pelvis, it may be "moveable" or "floating." At times the adult kidney maintains the lobulated character it possessed in fœtal life. A kidney when loosely connected may appear as a moveable abdominal tumour, and in exceptional cases be the seat of much distress. In such, operative surgery may be required, *vide* nephrorraphy, page 66.

General remarks on disease of the kidney.

The diseases of the kidney are generally regarded as belonging to the physician, but I need hardly add that a thorough knowledge of renal pathology is as requisite to the Surgeon as it is to the medical practitioner, for, without such a knowledge, he will neither be able to recognise the different conditions of the urine with its deposits, nor to appreciate their significance. He will likewise be as unfit to decide upon the propriety of an operation of expediency, as to understand the risks of one of necessity; for the existence of kidney disease as a rule, is enough to debar the Surgeon from performing any operation other than that required to save life, and in such operations it renders the prognosis most unfavorable, since kidney disease is well known to be the chief cause of death after operations.

As a rule of practice the condition of the kidney, as expressed by the character of the urine, should be made out in all cases in which an operation is thought of, and more particularly in operations upon the urinary organs.

Nephritis.

On nephritis.

Causes.

Inflammation of the kidney associated with suppuration of the organ has long been recognised as a common consequence of obstructive disease of the urinary passages. But it may occur as a consequence of local injury, or as an acute attack upon a chronically diseased organ, or as a consequence of pyæmia or other cause. It is also very common as a sequel to Bright's disease of the kidney—that is, to disease of the secreting structure of the organ—in consequence of some local source of irritation in any part of the urinary passages. Bright's disease by itself is not a suppurative disease.

Suppurative nephritis.

Suppurative nephritis may occur as an *acute* or as a *chronic* affection, though more frequently as an *acute upon a chronic* disease. After death, a kidney thus affected may appear enlarged, with its substance more or less filled with suppurating cavities. When the inflammatory action is confined to the mucous lining of the pelvis of the organ, it is called "*pyelitis.*" At times, the kidney is a mere cyst or shell containing pus and broken down tissue, and, in extreme cases, the kidney and parts around form one large suppurating cavity. This condition is not rare as a consequence of the breaking up of tuberculous matter, and then it is usually symmetrical.

Symptoms and diagnosis.

Symptoms and Diagnosis.—When after an injury in the loins, or in the course of some obstructive vesical, urethral, or calculous affection, a patient is seized with rigors, severe pain and tenderness in the lumbar region, febrile disturbance, nausea, vomiting, scanty high-coloured and possibly bloody urine, and irritable bladder, *acute nephritis* may be suspected. When rigors recur frequently and there is suppression of urine with renal casts or pus in the urine, suppuration of the organ is to be diagnosed; and, when to these symptoms are added severe depression, anasarca, and brain symptoms passing on to coma, uræmic poisoning may safely be expected.

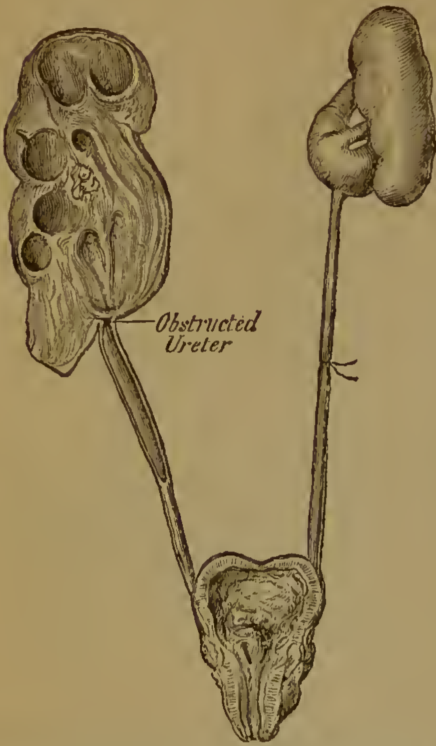
On chronic nephritis.

But chronic nephritis is a more common affection than the acute; indeed, unless from accident, the acute is generally a sequel to the

Causes.

chronic. Kidney disease is a common consequence of long standing or neglected bladder or urethral mischief. When a stone has existed for any period in the bladder, and has set up inflammation of that organ; when from prostatic disease the same result ensues; or, when from stricture, the urinary organs have been subjected to irritation, and distension from retained urine, the ureters and later on the pelvis of the kidney, and subsequently the secreting structures of the kidneys themselves become inflamed by extension from the bladder. Under these circumstances, every gradation of dilatation, inflammation, or suppuration of the whole urinary passages may be found; the bladder may be enormously thickened and inflamed; the ureters dilated, tortuous, thickened, and suppurating; the pelvis of the kidney expanded and filled with pus—"*pyelitis*"—and the kidney itself more or less undergoing disorganising changes. (Fig. 319.)

Fig. 319.



Suppurative disease of the kidneys, dilatation of ureters, hypertrophy of the bladder, &c., the effect of urethral obstruction. Drawing 368^{65}, Guy's Hosp. Mus.

Symptoms.

The symptoms of changes such as these are not very definite. In all *long-standing* examples of obstructive urinary affections some of them may be suspected; so also in all cases of neglected stone, particularly when bladder symptoms are marked; in cases in which the urine is albuminous, pale coloured, and smoky, or tinged with blood; when it contains pus in suspension, varying in quantity at different times, or shreds of lymph; when a dull aching pain is present in the loins, shooting round the hips into the groin and down to the testicles, when vomiting is constant and persistent, and the digestive organs do their work badly, and when sleep is difficult to secure, or superseded by a general drowsiness.

Diagnosis.

Under these circumstances, chronic kidney disease may fairly be diagnosed, with or without suppuration in the organ or around it.

When anasarca sets in, or brain symptoms from uræmic poisoning appear, the diagnosis is clear.

When rigors are frequent, even when not well marked, when lumbar pain is constant and increased on pressure, when on manipulation evidence exists of some deep-seated lumbar swelling and fluctuation

Abscess of kidney.

is distinctly or indistinctly to be made out, *abscess of the kidney* is fairly indicated. When with these a sudden discharge in the urine of large quantities of pus takes place, with relief to the local symptoms, it is probable that the abscess has discharged itself through the ureter; when the lumbar pain becomes more intense, the swelling more marked and prominent, and fluctuation more distinct, it is probable that the ureter has become obstructed, and the renal abscess is making its way through the loin externally; and many cases are on record in which, after the discharge of the abscess by natural or surgical means, a recovery has ensued. Indeed, stones have been taken away from or discharged from the kidney in this way with a good result.

Renal, like perirenal, abscesses are, however, prone to make their way through the diaphragm into the lung or into the colon, and cases are recorded where they burrowed downwards, and appeared below Poupart's ligament, or in the pelvis. In these cases the symptoms simulate spinal disease, the thigh being flexed upon the pelvis; this symptom, attended with lumbar pain or tenderness, being very constant in nephritic as in perinephritic abscess. Dr. Bowditch, of Boston, was the first to draw attention to the fact in 1869 and 1870.

Treatment of acute nephritis.

TREATMENT.—When acute nephritis originates from a blow or from the irritation of a renal calculus, complete rest in the horizontal posture in a warm bed is absolutely essential, with *milk diet* and the moderate use of simple diluents as milk and water, or barley water. Poppy fomentations to the loins always give comfort, and, when the pain is severe, leeching is beneficial; cupping has been recommended, and is of use. The bowels should always be well cleared out by some simple medicine, such as castor oil or an enema. All medicines that act upon the kidney, as salines or turpentine, all external applications, such as blisters, should be carefully avoided; and for this same reason stimulants ought not to be given.

The action of the skin should be encouraged by outside warmth, and the hot-air bath or steam bath applied to the patient in bed, is a valuable means to this end; a hot bath is a good substitute. Calomel and antimony cannot be recommended.

When the case passes into the chronic stage, counter-irritation becomes of value, and as this cannot be obtained by means of blisters, since cantharides act powerfully on the kidneys, mustard may be employed, or a piece of lint saturated with a mixture of chloroform and alcohol should be applied to the loin and covered with oil silk. Dry cupping also is of great value.

When *acute nephritis* supervenes upon the chronic form the result of long-standing disease of the urinary organs, or after operation, the whole aim of practice must be to soothe, relieve pain, and keep life going. Nothing like mechanical interference with the urinary passages must be thought of. Retention of urine should, of course, be relieved, but the utmost gentleness ought to be employed in the manipulation. These cases are, as a rule, very hopeless.

Treatment of chronic nephritis.

In *chronic nephritis*, the result of local disease, there can be little doubt that the best practice is the removal of the cause. When a stone in the bladder has set up the mischief it should be removed, and by that mode which induces the least local irritation. When a stricture of the urethra has been the cause it should be dilated, for as long as the local cause of the disease exists no recovery can be looked for. When calculus in the kidney is the local irritant, the Surgeon's aim must be to allay local irritation by keeping the patient quiet, and administering soothing remedies; the alkaline potash salts being prescribed where the urine indicates uric-acid calculus, and the mineral acids when the urine is phosphatic. The removal of the stone by operation may also be entertained (*vide* Nephro-lithotomy, p. 62).

When suppuration of the kidney takes place, with or without a calculus, and any external evidence of the abscess exists, the kidney should be cut down upon by a lumbar incision, the abscess freely opened, and drained after irrigation (*vide* Nephrotomy, p. 62).

When the urine is full of pus, the preparations of buchu are of undoubted value, and the mineral acids or the preparations of iron of use. Warm baths and diaphoretics, to induce free action of the skin, and by these means to relieve the kidney; with a supply of simple nutritious food, and stimulants only when absolutely required, make up the treatment.

On perinephritis.

Perinephritis is an affection that must be recognised, and although it may be more frequently found in connection with suppuration of the kidney, it is at times independent of it. It is indicated by a sudden pain in the loin, fever, and subsequently *lumbar swelling*, with frequently œdema of the integuments of the loin. The pain is at times constant and persistent, while at others it may appear and then disappear for an uncertain interval, to recur spontaneously in all its severity. The urine in an uncomplicated case is generally natural, and if at all altered, scanty; renal symptoms, so called, being absent. When the case is left to nature the inflammation may attack the chest and induce a fatal pleurisy, or the abscess may burst into the bowel or externally, burrowing beneath the fascia covering the psoas muscle and showing itself in the thigh or pointing in the loin. The Surgeon should not, however, leave these cases to nature, but cut down upon the abscess or lumbar swelling, as in colotomy, at the outer border of the quadratus lumborum muscle, and evacuate the pus as soon as sufficient evidence exists of its presence; from this treatment a good result may be looked for. (*Vide* paper by Dr. Bowditch, 'Am. Journ. of Med. Science,' 1871.)

Hæmaturia

On hæmaturia. Causes.

is a symptom met with in many diverse conditions, the hæmorrhage being limited or profuse. It may come from one or both the kidneys or any other part of the urinary passage, either as a result of some constitutional cause, such as the hæmorrhagic diathesis, or, some morbid condition of the blood, as in purpura, scurvy, smallpox, the plague, or fever. It may likewise be parasitic. Profuse renal hæmaturia takes place occasionally as an intermittent affection. It may likewise follow an injury or disease of the kidney, ureter, bladder, prostate, vas deferens, or urethra. In surgical practice the hæmorrhage is more frequently due to some local cause, yet the practitioner should be alive to the fact that it may originate from a constitutional one or from the use of such drugs as turpentine or cantharides.

Renal hæmorrhage.

If the hæmorrhage follow an accident, the diagnosis is seldom difficult, for when after an injury to the loin, blood is passed mixed with the urine, it may be inferred that the kidney has been injured, and when slender, cylindrical, pale pieces of fibrin are seen in the urine the Surgeon may be sure that they come from the kidney—these clots having been moulded in the ureter and washed down from the kidney by the urine. Blood also, when intimately mixed with the urine, has probably a renal origin.

The passage of a stone down the ureter is also attended by hæmorrhage, which is rarely profuse, and is, moreover, generally accompanied by severe colicky pain shooting down the groin and scrotum of the affected side, with a retracted testicle. When blood comes from a diseased kidney, it is mixed with the urine, as in cases of accident, and may be slight or profuse in quantity, but the nature of the affection or its being due to calculus will have to be determined by the history of the case, the existence of lumbar pain or tenderness, and a close examination of the urine. In cancer of the kidney pain rarely extends to the testicle.

Parasitic hæmaturia.

Parasitic hæmaturia.—This is common in Egypt, Syria, and the Cape, and is now known to be due to the presence of a parasite first discovered by Bilharz in 1851. Dr. Zancarol, of Alexandria, describes it as "Bilharzia hæmatobia." The disease is only found in weakly subjects and those who drink foul water, or the undistilled water of the Nile. Its early symptoms are the appearance of blood at the end of micturition, its passage being accompanied and followed by pain, frequent micturition and anæmia. With the parasite, there is cystitis which will go on and at last give rise to dilated ureters and diseased kidneys.

Dr. Zancarol ascribes the frequency of stone in the bladder in Egypt to the presence of the parasite.

The urine of patients the subjects of this disease contains blood and mucus but is of normal specific gravity. The ova of the parasite itself are to be found in it in an active condition for twenty-four hours after it has been passed. They are ovoid in shape, ciliated and $\frac{1}{160}$ of an inch in diameter. The worm itself never passes with the urine. It is filiform and three or four lines in length. A full description of the worm may be found in the 'Trans. of the Path. Soc.,' Dec. 9, 1882.

Little can be said about treatment beyond that Dr. Wastobet, of Beyrout, Syria, records ('Lancet,' Dec. 9, 1882) a case cured by one-drachm doses of the oil of turpentine in milk three times a day in twenty-four days.

Vesical hæmorrhage.

Vesical or prostatic hæmorrhage, either from injury or disease, chiefly shows itself as blood-clots mixed with the urine, the former passing either before or after the latter. The blood at first may fill the bladder; but after some days the urine will only be stained with blood. When the clot has broken up more or less discoloured irregular coagula with fimbriated edges will pass with the urine, these coagula being very characteristic of blood-clot. They may pass per urethram as rolled up masses, but, when floated out in water will present their natural shape; blood that has been retained within the bladder for any time will impart to the urine a porter-like aspect.

When blood flows at the end of micturition in small quantities, squeezed out, as it were by the bladder, a calculus or prostatic disease may be suspected; but the same condition is also occasionally met with in the irritable bladder of gonorrhœa, or, after the passage of "gravel."

When a cancer of the bladder or prostate, or a villous growth exists pieces of broken up tissue may be detected by the microscope in the bloody urine. In these cases, too, the hæmaturia will be intermittent.

Urethral hæmorrhage.—When after an injury to the perinæum or pelvis, or a sudden muscular strain, pure blood flows from the urethra, unmixed with urine, urethral mischief may be suspected.

Urethral hæmorrhage.

Urethral hæmorrhage irrespective of injury may proceed from a chancre, acute gonorrhœa, or an impacted stone. It may follow over-exertion, or the straining associated with the retention of urine or sexual intercourse. It may likewise take place after the forcible bending of an erect penis in a chordee, or during some sudden muscular exertion from a rupture of the vas deferens, as pointed out by Hilton, and, in rare cases, it may occur without any known cause, the blood flowing from the penis unaccompanied by any symptom of disease. I have recorded two such cases ('Clin. Surg.,' Chapter 47).

Urethral hæmorrhage as a result of catheterism is also common, and it may be caused by the introduction of some foreign body into the urethra.

Fallacies of blood in urine.

It should be remembered also that bile when concentrated, indigo, or other rare constituents of the urine, from diet or otherwise, may simulate the presence of blood, as may the black urine which results from the external or internal use of carbolic acid when absorbed in poisonous doses. This symptom, however, soon disappears on the omission of the remedy. In a case under my care in 1871, of a man who had a weak sore the size of a crown piece, which had been dressed with an oily lotion of carbolic acid one part to forty, the black urine appeared after the second dressing, associated with brain symptoms and collapse of the general powers, which I thought must prove fatal. The symptoms, however, speedily disappeared on withdrawing the drug, and a recovery ensued. In a case under my care five years ago, a boy, æt. 9, was unintentionally kept in a semicomatose state for two months, by the application of a lotion of carbolic acid (one part to a hundred) to a small sore, the brain recovering its healthy condition on the omission of the lotion. The poisonous action of the carbolic acid was detected through the urine, which was occasionally black.

Treatment of hæmaturia.

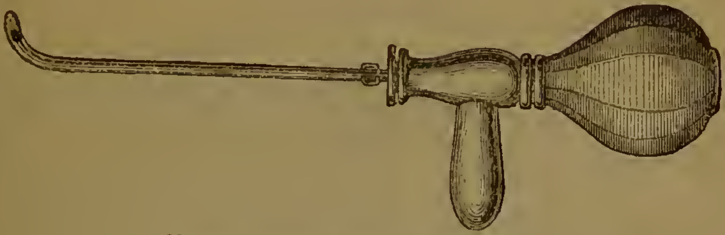
Treatment.—The disease or condition that gives rise to the blood in the urine requires treatment more than the symptom itself, but at times, the bleeding is so profuse as to threaten life. Renal hæmorrhage when profuse, may be checked by gallic acid in full doses, gr. v to gr. x three times a day, acetate of lead, tincture of ergot, or matico, opium being generally a valuable addition, and, in extreme cases the spirit of turpentine, absolute rest in the horizontal position, and cold milk diet should be also adopted.

When hæmorrhage into bladder.

Hæmorrhage from the bladder, when persistent, may be checked by the application of a bag of ice over the pubes and to the perinæum; by cold or astringent injections into the rectum, with rest and opium. There is no necessity to pass a catheter or to interfere with the clot, so long as the urine flows and retention does not occur—the urine at the natural temperature of the body being a good blood solvent. A clot of blood, when bathed with urine, as a rule disintegrates in the course of a few days, when it may be passed without help. Any disturbance of the clot when first formed will probably rather tend to encourage than stop bleeding, consequently, no unnecessary catheterism should be employed.

When retention present. When retention exists, the symptoms become urgent, and opium administered either by the mouth or, what is preferable, by the rectum, fails to give relief, the passage of a large-sized catheter and the use of an exhausting syringe, such as Clover invented for use after lithotrity, (Fig. 319A), or the aspirator may be called for; yet these measures should only be employed when an absolute necessity exists, and opium in full doses fails to give relief.

Fig. 319A.



Clover's syringe, as improved by Maunder.

Urethral hæmorrhage rarely continues for any time, or requires for its treatment more than rest in the horizontal posture, unless caused by some laceration of the urethra or more severe injury.

Suppression of Urine

On suppression of urine. is the result of renal disease, from which the kidneys ceasing to fulfil their functions, the constituents of the urine are left in the blood and give rise to coma and possibly to convulsions and death. Uræmia or uræmic poisoning is then said to be the cause of death. It may occur at any stage of kidney disease, and not uncommonly follows an operation performed on a patient the subject of such an affection; it is a result to be taken into calculation before undertaking any operation where albuminous urine exists.

In exceptional cases, however, suppression of urine occurs when no such chronic mischief can be detected, coming on suddenly, as it often does, without cause, and leaving as suddenly without any reason. I once saw a musician who secreted no urine for sixty hours, and then passed what seemed to be a natural quantity; his only other symptoms were those of slight feverishness and headache. In such cases, the hot air, vapour, or warm bath are the best remedies.

Stone in the kidney

On stone in the kidney. is not an uncommon affection, and is generally painful and often fatal. At times, however, large stones are found in the kidney after death which gave no signs of their existence during life. When the stone becomes impacted in the organ and ceases to be moveable, it does not give rise to any marked symptoms; and, comparatively speaking, ceases to interfere with life; more frequently, however, it often excites much local irritation, if not suppuration, and usually kills by destroying the kidney by converting it into a suppurating cyst. Small stones are constantly formed in the kidney and passed through the ureter into the bladder. Large stones may so increase as to form a cast of the pelvis of the kidney (Fig. 336), and at times attain enormous dimensions.

Symptoms of stone in the kidney and ureter.

The symptoms of stone in the kidney are, a tendency to rigor; lumbar pain increased by riding or any jolting of the body, the pain passing down the groin into the testicle of the affected side and causing its retraction; irritable bladder, and blood in the urine. Irritability of the bladder may be the only symptom of renal disease. When the stone enters the ureter, the inguinal and testicular pain becomes increased, and a colicky pain appears, attended often with sickness and even collapse, the bladder becoming more irritable and the urine more bloody. When the stone passes, all these symptoms suddenly cease, the bladder irritation probably alone remaining. As time goes on, and the local irritation becomes worse, some suppuration in the kidney may occur. As long as the ureter remains open, and pus makes its escape into the bladder, the symptoms are not urgent; but should the ureter become closed by the stone or some inflammatory change, the pus will collect and give rise to lumbar renal abscess. At times, this lumbar swelling may be felt; indeed, in thin subjects, with one hand in the lumbar and the other in the hypochondriac region, a calculus may by palpation even be made out in the kidney; this examination will be made occasionally with advantage when the patient is under an anæsthetic. The lumbar swelling may so increase as to form a large cystic abdominal tumour. When the ureter is obstructed, this result will take place more rapidly than when it is open, from the accumulation of pus; but when it is open the pus flows into the bladder and passes with the urine as turbid urine. When allowed to settle in a porringer or glass, its presence will be readily detected. Pus poured into the bladder from the kidney or elsewhere is mixed with but little mucus; but when formed in the bladder is mixed with much. Pus and mucus secreted from the bladder is constant in the urine, when from the kidney it may be intermittent. Dr. Owen Rees has pointed out the value of the tincture of galls, added guttatim to the urine of patients who may be suspected to be suffering from renal calculus, this tincture producing an immediate flocculent precipitate of a light brown colour when any of the extractive matters of the blood are present (' Brit. Med. J.,' Oct. 21, 1876, p. 518). He also asserted that a heavy and continued pain over the sacrum may be the only prominent clinical symptom of this affection.

May give rise to lumbar renal abscess.

Treatment of stone in the kidney.

TREATMENT.—When a stone has formed in the kidney, the happiest result is its passage into the bladder, which end can be facilitated by the administration of diluents, particularly water, as well as alkaline preparations of potash, such as the citrate, tartrate, or bicarbonate. When strong evidence exists of local irritation, opium or henbane, given either by the mouth or the rectum, are valuable drugs; while a subcutaneous injection of morphia over the affected kidney at times acts most beneficially. Fomentations about the loin and groin, or the warm bath, also give much relief.

When passing down ureter.

When the stone is passing down the ureter, the same practice is to be followed, a warm bath and a full dose of opium often relaxing the parts and favouring the passage of the stone. The administration of an anæsthetic by inhalation may, when the pain is severe, under these circumstances also be tried. In a case I was called upon to see, where extreme agony existed, instantaneous and permanent relief followed the practice, the stone having passed during the inhalation of the chloroform.

When impacted in kidney.

When the stone has become impacted in the kidney and gives rise to periodical attacks of pain and constant uneasiness—each attack being worse than the last—important questions occur to the Surgeon. Is it to be allowed to remain, where it may, in all probability, set up irremediable disease if not destruction of the kidney? or, is an attempt to be made to remove it by surgical operation? The answer at the present day is very decided. The Surgeon should remove the stone.

Operative interference.

Renal Surgery.

Renal surgery.

This branch of surgery has reached a definite position, and if it rises in value as it has risen in interest a wide surgical field has, indeed, been opened. It is to Simon, of Heidelberg, that we are indebted for its birth, in that he, in 1869, first designedly removed a kidney with success. He did so for a urinary fistula of the ureter, which had resulted from an ovariotomy.

Different operations.

Since then, writes Clement Lucas, in an able article ('British Med. Journ.,' Sept. 29, 1883), "*nephrectomy* (removal of the kidney) has been performed upwards of a hundred times. '*Nephrotomy*,' or incision and drainage of the kidney, has become a much more frequent operation, and renal lithotomy, '*nephro-lithotomy*,' has been successfully extended to cases where no tumour or sinuses exist;" and the credit of this last triumph must be given to my friend Mr. Henry Morris (*vide* 'Trans. Clinical Society,' vol. xiv, p. 30, 1881).

A fourth operation, named "*Nephrorraphy*," must also be mentioned—an operation first performed by E. Hahn, of Berlin ('Centralblatt für Chirurgie,' July, 1881), which consists in cutting down upon and exposing a moveable or floating kidney, and stitching it to the edges of the parietes of the lumbar wound.

Last, but not least, "*paracentesis*" of the kidney claims a notice.

Upon each and all of these surgical proceedings a few observations will be made.

Paracentesis of the Kidney.

Tapping kidney.

This operation is valuable for diagnostic as well as curative purposes, and it may be performed either by way of aspiration or by means of a trochar, in cases in which it is well to be assured of the presence or absence of fluid in any given dull lumbar swelling.

In hydronephrosis or dropsy of the kidney, brought about by the retention of urine in the pelvis of the kidney from obstruction of the ureter—in those rare examples of isolated serous or blood cysts of the kidney, and hydatid cysts, this operation is particularly valuable.

For the diagnosis of pyonephrosis it is equally of use, and even where the tumour may turn out to be of a solid nature, a fine aspirating needle is not likely to be followed by harm.

The best position for tapping the right kidney "is one half way between the last rib and the crest of the ilium, between two or two and a half inches behind the anterior superior spine of the ilium" Morris ('Med.-Chir. Trans.,' vol. lix, p. 242) and for the left, according to

Mr. J. Thomson, of Nottingham, "the interval between the last two ribs near their anterior extremities" ('Path. Soc. Trans.,' vol. xiii)

Nephrotomy.

Nephrotomy, or an incision into the pelvis or substance of the kidney, is called for in cases of abscess of the organ, whether from stone or tubercle, or of pyonephrosis from whatever cause, and for hydronephrosis and hydatid when the simple operation of paracentesis has failed to bring about a cure. It essentially consists of exposing, opening, irrigating, and draining the abscess cavity in the same way as any other abscess cavity should be treated.

Cases.

I have followed this in practice on many occasions, having in a man cut down upon a suppurating kidney and evacuated several ounces of pus with marked benefit, and in another opened and drained a large suppurating renal cyst through the left loin.

Operation simple.

On August 31st, 1876, I likewise cut down upon the right loin of a lady, æt. 27, whom I saw, in consultation with Dr. Moore and Mr. Pocock, of Brighton, with a swelling which we diagnosed as renal, and evacuated three pints of fœtid pus—the lady making a good recovery. In 1877 I cut into the left loin of a woman with a lumbar swelling, and let out a quart of pus with marked benefit, my finger readily passing into the dilated pelvis of the kidney, and in 1883, I opened the right kidney of a man which twelve years before had been seriously injured, and evacuated 86 oz. of fœtid pus, subsequently irrigating with iodine water and syringing the cavity. He was well in three months.

The operation in its several steps, should be the same as that described for lumbar colotomy, the kidney being readily reached and dealt with through such an incision as was there indicated.

Nephro-lithotomy.

Article 'International Encyclop.,' vol. v.

When required.

Nephro-lithotomy, writes Henry Morris, who was the first Surgeon who designedly cut down upon a kidney to remove a stone (*vide* 'Clin. Soc. Trans.,' vol. xiv, p. 30, 1881), "should unhesitatingly be done in all cases in which symptoms of renal calculus continue uninfluenced by medical treatment, and are sufficiently severe to interfere materially with the comfort and usefulness of the patient's life. If for several months a person has been subject to more or less constant pain in one loin and along the ureter, and perhaps, also, in the testicle of the same side, if there have been recurring attacks of renal colic, and especially if with these symptoms there is occasional hæmaturia, or the urine is constantly charged with a little pus or albumen, we have the conditions not only justifying but demanding an exploration. If in addition to these symptoms a small calculus or a little calculous matter has been passed per urethram, there is almost absolute certainty of the presence of a stone; at the same time it must be recognised that symptoms strongly suggestive of renal calculus arise from other causes than stone."

Operation.—I give this in the words of Mr. Morris :—"An incision is made four and a half inches in length parallel with and three quarters of an inch below the last rib. The structures divided are the same as in nephrotomy. If the quadratus lumborum be so wide as to contract the deep part of the wound its outer edge may be incised to the extent of half or three quarters of an inch. All bleeding vessels having been twisted and hæmorrhage quite stayed, the assistant should stretch the edges of the wound widely apart by suitable retractors, and the operator with two pairs of dissecting forceps, tears through the perirenal fat. As he approaches the back of the kidney there will be sometimes noticed a difference in the character of this fat, that immediately in contact with the kidney being finer in texture, and of a delicate primrose colour. If, from the presence of the stone, there has been inflammation in the tissues around the kidney, this appearance will not be expected, and the whole of the tissue will probably be dense and tough.

Operation continued.

"When the kidney has been fairly reached the index-finger should be passed carefully over the whole of the posterior surface of the organ, including its pelvis, and any inequality of surface, or increased hardness or resistance at any particular spot, should be searched for. During this tactile exploration, indeed throughout the whole of the examination of the kidney, the abdominal walls of the patient should be well supported by an assistant or well-arranged pillows, so that the kidney should not be pushed forwards by the exploring finger. If nothing suggestive of the presence of a stone is thus felt, the kidney should be freely exposed to view by drawing aside the edges of the wound, and a fine needle should be passed into the renal substance. This should be done in a systematic way and in several places, if the stone be not at once struck, introducing the needle here and there, so as to puncture in succession the several calyces of the kidney, in one or other of which experience tells us the stone usually rests. If in the course of the digital exploration some one spot gives more resistance than the rest, this should be first punctured, but otherwise the puncturing should be done in a well-planned manner. On this point I would lay great stress, as it is quite possible to puncture in a dozen places, and yet to miss the calculus.

Sounding kidney.

"If by this means the calculus is not detected the search should not be given up until the fingers of the right hand are passed round the outer edge of the kidney, and the front surface felt over in the same way as the posterior. Whilst doing this, in order to give counter-resistance to the exploring finger, the kidney may be pressed against the psoas muscle, or be squeezed between the finger and thumb. Despite all these means a calculus may escape detection. I have recently removed by lumbar nephrectomy a healthy kidney for a calculus the size of a marble embedded in it, but which I could not localise. The man recovered well, but the loss of a good kidney is a very regretable feature in the case. The kidney becomes very hard and tough under the prolonged irritation of a stone, so that whilst the whole organ feels firmer than natural, any slight difference in the degree of resistance of one part is more difficult to appreciate. This hardness of the renal substance should make the Surgeon very suspicious of a calculus, and future experience will, I think, encourage him, when this condition is present, not to be satisfied, either that no stone exists, or that nephrectomy must be performed, until he has made such an incision into the kidney as will open each of the calyces. Kidney wounds are known to heal readily, and whilst the risk of such an incision would not equal that of nephrectomy the subsequent condition of the kidney would be preferable to the possession of only one of these organs.

Detection of stone.

"Having detected the stone by one or other of the methods above described, the overlying parts of the kidney should be cut into with a probe-ended straight bistoury, and then with a scooping movement of the finger, introduced through the incision, the stone, unless a branched or a very large one, can be raised to the surface of the parietal wound on the point of the finger; or a pair of forceps might be passed into the kidney by the side of the knife, and the stone seized and withdrawn. The finger is, however, much to be preferred, and if the incision is small, as it ought to be, the finger serves the purpose of plugging the renal wound, whilst it lacerates the renal tissue to the necessary extent. By this plan the hæmorrhage is minimised; and the rent made with the finger heals as readily as the cut. When equally convenient to reach the stone it is much best to open the secreting structure, and not the pelvis of the kidney. The wound in the former heals better than in the latter, and the chance of a urinary fistula is much less. If the calculus be large and branched it may possibly be requisite to break it up into two or more fragments, and remove the fragments separately. I have known this done in a suppurating kidney, but it is not probable that a stone will attain such a size as to require breaking before removal, without having in its growth more or less destroyed the kidney structure. A stone one ounce in weight has been removed entire from a kidney, not markedly enlarged, nor the seat of advanced suppuration (Bennett May, 'Clin. Soc. Trans.,' 1883).

After-treatment.

"The after treatment is very simple: a drainage-tube should be left in the back part of the wound, and the rest should be closed by sutures. For a time, of course, the whole or greater part of the urine secreted by the injured kidney will be discharged through the loin, but after gradually diminishing, this may be expected to cease altogether in from three to four weeks.

"These loin wounds usually heal very quickly. In nephrotomy, as in nephro-lithotomy, some simple dressing, such as lint soaked in terebene and oil, or spread with boracic ointment, should be applied over the wound, and the drainage-tube should pass through this, and be covered with a thick pad of absorbent cotton wool, iodoform, or Lister's gauze, retained in place by a light bandage. The dressings will require frequent changing, as they soon become saturated with the urine. To keep the bedding dry, a large pad of finely-powdered German moss peat should be placed beneath the loin to receive and absorb the urine, which it readily does.

Dangers of operation.

"The dangers of nephro-lithotomy are not great, so far as we can judge from present experience. The operation hitherto has, it appears, been uniformly successful, but the number of cases as yet recorded is but few.—1. *Hæmorrhage* from the wounded kidney is not likely to be serious if the plan suggested above be followed. There may, perhaps, be a formidable-looking gush on first dividing the tissue, as in Mr. Beck's case, but compression with the finger or a sponge will soon check it. 2. *Cellulitis* may follow the operation, but with due precaution as to antiseptic cleanliness and drainage this will almost certainly be escaped. It may, however, occur; and I am aware of one case in which extensive suppurative cellulitis followed an exploratory incision in search of a renal calculus; pus burrowed downwards to the pelvis and upwards until the abscess burst into the lung, and though the patient ultimately recovered he nearly lost his life. 3. *Renal abscess* might possibly follow the operation as the result of wounding an organ already long irritated by the presence of a calculus. I do not know of it having occurred, and it is much more probable that any morbid change started by the calculus would be checked and repaired by the removal of the cause, a result which is proverbially known to occur in other tissues of the body. 4. A renal fistula, or a mere superficial purulent fistula may

Hæmorrhage

Cellulitis.

Renal abscess.

follow; but, though the chances are against it, such a result would be a welcome substitute for the ceaseless pain and chronic invalidism of the condition which it replaces.

Nephrectomy.—This operation has been successfully performed at intervals for years; in some cases on account of injury, and in others by mistake, renal tumours having been removed as an ovarian; but Simon, of Heidelberg, was the first Surgeon who designedly performed it, and with success, by the lumbar operation.

Cases of extirpation of kidney.

Dr. Brant, of Klausenburg, on June 7th, 1872, removed the left kidney of a man, æt. 27, which had escaped from the loin through an opening caused by a stab four days before. He tied its pedicle in two portions with a silken ligature, and recovery took place without a bad symptom. ('Wiener med. Woch.,' Nov. 29th, 1873.)

On December 2nd, 1873, Dr. A. Campbell, of Dundee, removed the kidney that was the subject of cystic disease through an abdominal incision, having mistaken it for an ovarian tumour, and the patient, who was a widow, æt. 49, made a good recovery. The pedicle was ligatured with carbolized catgut. ('Edin. Med. Journ.,' July 1874.)

Nephrectomy may be performed by an "*abdominal*" or "*lumbar*" incision, and there can be no question that the latter is the right one to select in all cases in which the kidney is small and yet sufficiently diseased to justify its removal.

The abdominal incision should be reserved for large tumours which cannot be taken away by the lumbar.

Lumbar nephrectomy.

Lumbar nephrectomy is at all times a serious operation, and is only to be undertaken after mature consideration. "It is only permissible, says Simon, when a patient's life is seriously threatened by disease and all other remedies have failed." It should, however, be entertained when one organ is seriously disorganised from calculus or other causes, and when the minor operation of nephrotomy has failed or seems inapplicable; when the organ is the seat of a tumour otherwise incurable, or the subject of urethral urinary fistula seriously interfering with life's duties. It seems likewise applicable to certain examples of ruptured or wounded kidney, in which nature cannot be expected to bring about or has failed to secure repair.

It should never be undertaken unless evidence exists as to the probability of the other kidney being healthy, as evinced by the normal condition of the urine as to quantity and quality, and the absence of albumen over and above what can be explained by the presence of pus due to the disease of the affected organ.

It does not appear to be applicable to disorganisation of the kidney from tuberculous disease, such an affection being usually double.

The operation itself should be made much upon the same lines as that of nephro-lithotomy.

Should more room be required in the incision, it can be gained by a vertical cut made at right angles to the spinal end of the wound, this incision not only facilitating the removal of the kidney and the application of ligatures to its pedicle, but being very favorable for drainage.

The kidney should be enucleated by the finger, and this is, as a rule, readily effected. Where difficulty is felt the capsule may be left.

The pedicle should be secured by means of a double ligature of silk passed on a long and strong aneurism needle, and it is well to tie the ureter and vessels separately. The kidney should next be well dragged out of the wound, and to facilitate this the lower ribs should be forcibly drawn upwards. If the ligatures do not appear to be securely tied, a second one should be put on; before the kidney is separated the pedicle should be cut through with scissors.

All bleeding points should at once be seized as they present themselves and secured either by ligature or forceps. All the ligatures should be cut short. Any wound of the peritoneum should be sutured. The wound should then be treated as any other deep wound, that is, well washed out with iodine water, and drained. Enough sutures should be introduced into the wound to keep the parts together, but a free outlet should be left. A large pad of absorbent cotton and gauze may then be adjusted over the loin to absorb discharge, and the patient left alone for nature's reparative powers to bring about a cure. The simplest food is the best; the nearer a milk diet can be maintained the better. Convalescence has been generally secured in about four weeks.

Abdominal nephrectomy.

Abdominal nephrectomy is only to be entertained when the lumbar is inapplicable, and had I to do it, I should use the incision which approaches that illustrated in Fig. 148, the upper end of the incision being made to pass more obliquely below the last rib. Langenbuch, of Berlin, makes his, along the outer border of the rectus abdominis, the midpoint of the incision corresponding to the umbilicus.

All the details of the operation are to be conducted with all the care observed in an ovariotomy.

The statistics of the operation up to the present are:

Out of 96 cases, well reported, 54 recovered and 42 died. Of these, 46 were made by the abdominal incision, of which half died, whereas of the 50 made by the lumbar, 31 recovered and 19 died. The result of the operation seems, however, to turn more upon the disease demanding it. Thus, of 18 cases for cancer, 9 died; of 16 cases for floating kidney, 6 died; 7 for uretral fistula, all lumbar, 6 recovered, 1 died.

Nephrorraphy.

Nephrorraphy is an operation undertaken for the relief and fixation of a kidney which is freely *movable* behind the peritoneum. It is clearly inapplicable to such rare cases as are found to possess a mesonephron, and are *floating* kidneys. It should, however, be undertaken only in exceptional cases. It consists in a lumbar incision as for nephrotomy, after the exposure of the kidney, which is greatly aided by an assistant pressing it well to the wound from the abdomen, the capsule and cortex should be firmly stitched by six or more sutures to the margins of the lumbar wound, the wound subsequently being left to granulate. The operation was first performed by Hahn, of Berlin, in 1881, and it has been repeated by Langenbuch, Martin, Küster, Esmarch, Weir, Newman, and others, with sufficient success to justify its adoption in such exceptionally troublesome and painful cases of the affection as are occasionally met with.

The operation up to the exposure of the kidney is the same as that of nephrotomy, and later on consists in the application of strong catgut sutures between the renal capsule and the margins of the lumbar wound. The kidney by this process is stitched back to the loin, where it becomes ultimately fixed. The wound after this should be dressed so as to heal by granulation. The operation of nephrectomy for this affection is hardly justifiable.

For papers on this subject refer to *Thomas Smith's* 'Med.-Chir. Trans.' for 1869; to *Lucas's* 'British Med. Journal,' Sept. 29, 1883; to *Henry Morris's* 'Ashhurst's International Encyclopæd. of Surgery,' vol. v; *Czerny* of Heidelberg, 'Trans. Internat. Med. Congress,' 1881, vol. ii, p. 249; *Barker*, 'Trans. of Med.-Chir. Soc.,' vol. lxiii and lxiv; *Hahn*, 'Centralblatt für Chirurgie,' July 23, 1881; 'American Journal of Med. Science,' Jan., 1873; July, 1874; also paper by *Harris*, 1882; *David Newman*, M.B., 'Glasgow Med. Journal,' August, 1883; *Dr. Weir*, 'New York Med. Gazette, 1884.

CHAPTER XXI.

DISEASES OF THE BLADDER AND PROSTATE.

Irritable Bladder.

On irritable bladder.

ALMOST every disease of the urinary organs from the kidney downwards manifests its presence by some bladder symptom, and that symptom is usually what is called an *irritable bladder*, that is, the patient passes urine more frequently than natural, with or without pain.

Causes.

Such a symptom may indicate some slight deviation from the healthy relations that ought normally to exist between the bladder and its contents; or the presence of a severe if not fatal organic disease. It may be a result of some irritation of the glans penis associated with retained sub-preputial secretion, or an adhesion between the glans and prepuce; or, it may be due to a serious cerebral or spinal affection. It may indicate kidney, bladder, prostatic, or urethral disease, and, in many instances, it is the one symptom that has induced the patient to seek advice. The "*irritable bladder*," therefore, though only a symptom, is clinically an important one, and demands elucidation at the commencement of a chapter on bladder affections.

Long and adherent prepuce in child.

Irritability of Bladder in Children.—When this symptom is well marked in a male child, the condition of the penis should first receive attention; since, if the prepuce be long or adherent to the glans penis, and the secretion from Tyson's glands from want of cleanliness, have accumulated and become indurated, there will be strong reason to believe, that the irritability of bladder is the direct product of these apparently simple causes, for any of these conditions of the penis are sufficient to produce every degree of bladder irritation, and a cure can only be obtained by their removal. To secure this end, all retained secretion should be taken away, adhesions between the glans penis and prepuce carefully separated, and, if the prepuce be long, circumcision performed. If, however, on a careful examination no such conditions are to be observed, the state of the bladder should be inquired into, and for this purpose a sound passed (an instrument with a bulbous extremity being preferred) (Fig. 343), and, if a stone be detected, the cause of the symptom will be clearly explained, as well as the practice to be followed. It must be remarked, also, that if a calculus be the cause, a careful inquiry will probably detect the presence of other symptoms such as pain after micturition, hæmaturia, and an occasional interruption to the flow of urine—the intermitting urinal flow being very characteristic of the presence of a stone, although all these symptoms may be present in irritable bladder from an adherent pre-

Calculus bladder.

Rough bladder.

Altered character of urine.

Treatment of irritable bladder.

Worms as a cause.

puee. When the stone cannot be felt, it is not at once to be assumed that no such cause exists; for, on a subsequent examination, it may readily be discovered, the calculus having been probably covered by one of the folds of mucous membrane of a partially contracted bladder. If, however, a second examination fail to strike it, the condition of the bladder should receive attention; and if to the sound its mucous lining feels rough, and the presence of the instrument cause more or less pain and a desire to micturate, the urine will probably be found altered in character, and, after standing, will show a cloudy deposit of mucus, if not of pus; the latter deposit being very rare, however, in young subjects. Under these circumstances the general health of the child will require attention, as it may happen that some slight aperient or alterative or an alkaline mixture of potash, or perhaps a tonic may be required; the object being to make the urine as unirritating as possible, and thereby to allow the vesical mucous membrane to return to its normal condition. Rest, also, as far as it is possible to be secured, should be enforced. The diet ought to be of the simplest nature, and meat given in moderation, since it will probably be found that the urine is unnaturally loaded with lithates, if not with lithic acid, and this tendency to the deposition of such ingredients would be increased by the free administration of animal food. When, however, a case of irritable bladder in a child presents itself, in which none of the conditions alluded to are found, and in which the penis, urethra, and bladder, appear perfectly natural, the state of the rectum should be inquired into; the presence of worms, and more particularly of ascarides, being quite sufficient to produce an irritable condition of the urinary organs. These may be removed by a jalap purge or an enema of some bitter vegetable infusion, such as quassia; but the condition of the digestive apparatus will require attention, as influencing the presence of worms.

Excluding the presence of a stone as a cause of irritable bladder in young children, and in obstinate cases the probability of some villous growth, this affection is not one of serious importance if its true cause can be accurately recognised; since the conditions upon which it depends are easily remediable, and the irritability of the bladder rapidly disappears on their removal.

Irritable bladder in the adult.

Irritability of Bladder in the Adult.—In adult life, this symptom cannot be regarded in such a favorable light as in a child, since it is too often associated with conditions which are of a very serious nature and are by no means readily removed, although in the adult, as in the child, a congenital or an acquired phimosis, with a contracted preputial orifice, or adhesions between the prepuce and the glans penis, are sufficient conditions to produce this symptom.

May be a symptom of stricture.

As a symptom of stricture, the irritable bladder is not without its value; and, as a rule, it indicates considerable narrowing, as well as probably a contraction which has been so gradual in its progress as to escape notice until this irritability of bladder enforced more accurate observation, and induced the patient to seek advice. It must be regarded as a result, therefore, of a urethral stricture which can only be relieved by the removal of its cause. Doubtless it is produced by some chronic inflammatory action of the vesical mucous membrane, and, as such, requires treatment, viz. the dilatation of the stricture, absolute rest, and the administration of alteratives.

A symptom of enlarged prostate.

As a symptom of *enlarged prostate* (or of atony of the bladder in the aged, in whom no prostatic enlargement exists) this irritability of bladder is a complication of serious import, for in both classes of cases it is due to a want of power on the part of the bladder to empty its contents; in the one case from a mechanical obstruction caused by the prostatic tumour, in the other from a loss of power in the parts—the residual urine under both partially decomposing, becomes ammoniacal, and in this way acting as an irritant to the mucous membrane of the bladder, thereby giving rise to the irritability.

The treatment of these cases is not, therefore, a task of difficulty; the removal of the residual urine, and the prevention of its subsequent retention by the cautious employment of a catheter being the most important, together with the frequent washing out of the bladder with warm water, or, water medicated by some solution of morphia, opium, quinine, boracic, or nitric acid.

Diagnostic inferences.

The recognition of the cause of the symptom, however, is the main point to be remembered, the practice to be followed readily suggesting itself when the cause is understood. As a sign of gravel, an irritable bladder is of importance, and a careful examination of the urine will determine its true meaning. As a symptom of calculus in the bladder, it is constant and valuable, although in some cases of stone it is extraordinary how little irritation the presence of a calculus will produce. As a sign also of organic disease of the bladder, irritability must not be passed over. The obscurity of this class of cases is, however, very great, and the correctness of diagnosis must rest upon the combination of many symptoms, none being of greater value than another. In women, this symptom is a common accompaniment of uterine affections, while in both sexes it is often associated with rectal disease.

May be due to renal affection.

Last, but not least, this irritability may be the product of a *renal affection*, the urethra and bladder being perfectly sound. When, therefore, bladder symptoms exist, and a careful examination fails to discover any disease in the bladder or urethra, it may fairly be assumed that some renal affection is the cause. But a careful chemical and microscopical examination of the urine is alone sufficient to enable the Surgeon to arrive at anything like a correct diagnosis.

Irritability of bladder may also be produced by some cerebral or spinal disease, but the fact can merely be alluded to in these pages.

Caution.

The passage of a large quantity of urine, as in diabetes, should not be mistaken for irritability of bladder.

Inflammation of the Bladder.

On cystitis.

Cystitis is a common consequence of stone, prostatic disease, stricture, or gonorrhœa, and is usually *chronic* or *subacute*—the more acute symptoms mostly supervening upon the chronic. As an *acute* idiopathic disease it has been described by authors, but clinically such cases are very rare. The most acute are those occurring in gouty subjects as a catarrhal affection.

Chronic cystitis.

The *chronic* form is the direct consequence of local irritation produced by the presence of a tumour, stone, or other foreign body; although it is found wherever the flow of urine is interfered with from either prostatic disease or urethral obstruction; the bladder in these cases being irritated by the retained and decomposed urine as well as by its own ineffectual attempts to evacuate its contents. A similar result likewise ensues when the bladder is paralysed and unable to expel its contents, from over-distension, spinal injury, or disease. It is under these circumstances the more acute forms of cystitis and the worst pathological conditions are found.

Subacute cystitis is commonly the result of gonorrhœa, the inflammation of the urethra spreading to the bladder.

Seat of cystitis.

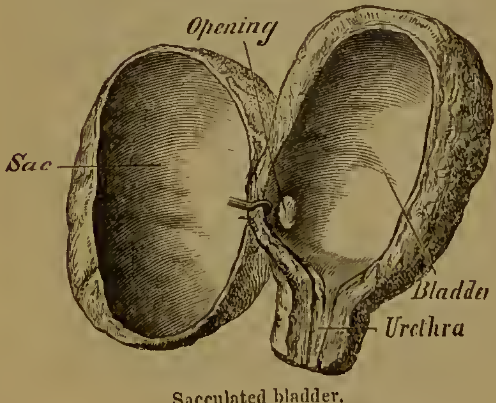
The seat of the inflammation is the mucous membrane, which becomes rough, covered with flakes of adherent lymph and phosphatic secretion, thickened, and at times ulcerated, and, in the acute forms of the affection, detached in fragments or as a whole, and thrown off as a slough. This latter condition is generally met with in the bladder of the paralytic, and in women who have had their bladders much distended from retention. It is probably as much due to the deficiency of nerve supply as to the intensity of the inflammatory mischief, rough catheterism having often too much to do with it.

Condition of bladder in chronic cystitis.

Sacculated bladder.

In chronic cases, the walls of the bladder become greatly hypertrophied from over-action, thick muscular bands being visible, and, where the obstruction to the exit of the urine has been of long standing, this thickening of the walls of the bladder is associated with its dilatation. Under these circumstances, it is common to meet with saccular dilatations of the mucous membrane, the mucous lining of the bladder becoming pressed outwards as a hernia between the bands of muscular tissue forming the walls of the organ. These pouches are usually small, though in exceptional cases (as seen in Fig. 320) they may be double the size of the bladder itself. Into one of these pouches a stone may occasionally fall and rest, thereby becoming encysted. At times these sacculi are multiple.

Fig. 320.



Sacculated bladder.
Prep. 2087^{75}, Guy's Hosp. Mus.

Sacculi of the bladder are met with chiefly in male subjects; they were found in 20 out of 3,000 post-mortem examinations made at Guy's; in 11 cases of stricture; 5 of stone; 1 of spinal disease; 1 of enlarged prostate. In one the cause was not clear. My friend Dr. Hale White recorded these facts with a case met with in a woman at the Path. Society, March, 1883.

Symptoms of cystitis.

Symptoms.—When the disease is subacute, the symptoms are irritability of bladder and inability to retain urine, the desire to pass water being often associated with its uncontrollable passage. The act of micturition is attended with pain, and followed by straining, blood being frequently squeezed out by the forcible contraction of the organ. Pain is mostly present above the pubes, in the perinæum and penis, often over the sacrum and in the groin. With these local symptoms, there may be those of more or less severe febrile disturbance.

Condition of urine.

The urine will be found to vary in character according to the cause of the disease. When it has originated from the extension of a gonorrhœal inflammation of the urethra, it will be cloudy from the presence of mucus, or even of pus, and at times stained with blood, this blood having been passed during the act of straining at the end of micturition.

In other cases of chronic disease (*catarrhal cystitis*), the urine will be mixed with greyish, viscid, ropy mucus, or muco-purulent fluid, which so sticks to the bottom of the chamber vessel and together as to fall like a glutinous mass when turned out. The urine will probably, in chronic cases, be alkaline or ammoniacal; in subacute, acid; in neglected cases, the discharge of mucus becomes enormous, and phosphate of lime often becomes mixed with the mucus and forms stone.

When ulceration exists.

When ulceration of the bladder is present all the symptoms are aggravated and the local pain severe. Bleeding is a common accompaniment, the blood being either mixed with the contents of the bladder and passed as dark-coloured urine, or as clots of blood.

In the cystitis of gonorrhœa, it is probable that the mucous membrane about the neck of the bladder is alone affected; in the more chronic cases of disease, the whole surface and submucous tissue is involved.

Treatment of cystitis.

Treatment.—Whatever may be the local cause of the cystitis, the local symptoms require attention, although in order to obtain a cure the removal of the cause is most essential.

Rest in the horizontal posture, hot fomentations or the hot bath, simple diluents such as barley water, linseed tea, milk and water, with alkalies as the salicylate of soda, citrate, or bicarbonate of potash in ten-grain doses. three times a day, and, above all, sedatives, are most essential. Of the sedatives, hyoscyamus is the best in half-drachm or drachm doses of the tincture every two or three hours, and where this is not enough, opium may be substituted; but where the kidneys are diseased, opium should always be given with great caution. The morphia suppository is an excellent remedy, so is an enema of starch with opium. The bowels should be relieved by enemata in preference to purgatives, although, when severe constipation is present, a good mercurial purge is often of value; leeches to the perinæum are sometimes serviceable.

When retention of urine complicates the case, catheterism is called for and an elastic catheter should be used with the utmost gentleness.

Treatment in chronic forms.

In chronic cases the infusions of buchu, uva ursi, pareira, or senega, and benzoic acid in ten-grain doses are excellent remedies; the tincture of cubebs or copaiba at times acts also beneficially; the triticum repens, in the form of a decoction, two ounces to the pint, is also a valuable drug. When gout is the assignable cause, colchicum, with five-grain doses of the carbonate of lithia, sometimes acts as a charm, and in some cases of gonorrhœal cystitis, the same good effect is often experienced. When stone is the cause, it should be removed; when stricture coexists it must be dilated; when enlarged prostate or atony of the bladder in the aged is the cause of the cystitis it is essential to keep the bladder empty, by the introduction of a catheter once or twice daily; in severe cases the bladder should be washed out, either by a stream of tepid water or medicated solution. Boracic

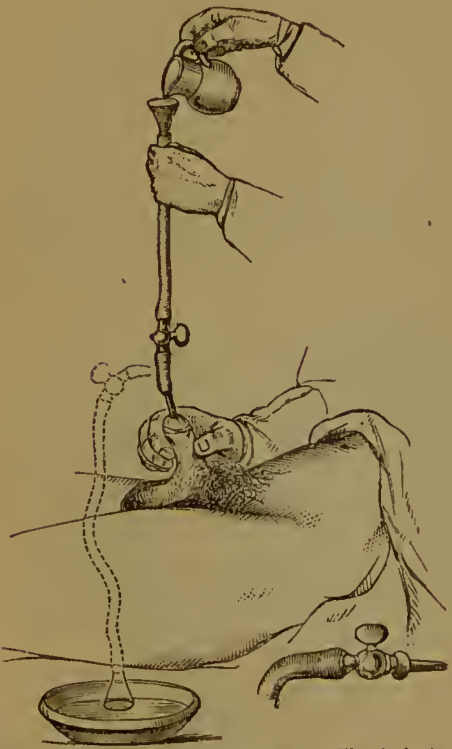
Washing out bladder.

acid ten grains to the ounce of water is the best form. Mr. T. W. Nunn speaks highly of a solution of two grains of quinine in 2½ ounces of water with a drop of diluted sulphuric acid. When the urine is fetid, Condy's fluid or a few drops of tincture of iodine, carbolic acid, or of one part of thymol dissolved in seven of glycerine may be added to the water.

Syphon method the best.

In washing the bladder the greatest gentleness should be observed; to force fluid into the bladder by a syringe is dangerous, unless in skilled hands, while to introduce more than three or four ounces of fluid is unnecessary. The best method is by means of the irrigating can or a piece of india-rubber tubing, two or three feet long, fitted to the top of the catheter after its introduction, and the gradual pouring of the water or solution made warm through a glass funnel fitted to the other end. The tubing can be raised to increase the pressure of the fluid, or depressed according to the necessities of the case; the bladder resenting the slightest distension by its contraction, and by the expulsion or elevation of the fluid into the funnel. By these means no harm can possibly accrue to an inflamed bladder, and the most atonic bladder can be emptied as with a syphon (Fig. 321).

Fig. 321.



Mode of washing out the bladder. The irrigator can may be substituted for the jug and hand.

Anodyne injections.

After the fluid has been introduced and left for two or three miuntes, it should be withdrawn, and fresh fluid poured in where necessary, the funnel being depressed below the level of the bed for emptying the bladder. Anodyne solutions are said not to be of much use in these cases, but I have been in the habit of introducing half a grain, more or less, of morphia, with apparent advantage, after the washing out of the bladder. When the washing out of the bladder increases the irritation it should be discontinued. At times a double catheter is of use, the injection flowing down one side, and the contents of the bladder out of the other.

Treatment of cystitis with atony.

In the inflamed bladder associated with atony, the tincture of the perchloride of iron is a valuable drug, or the dilute nitro-muriatic acid given in twenty-minim or half-drachm doses three times a day; but, in a general way, alkalies are called for, the urine naturally secreted being acid, and so as it is poured into the inflamed bladder becomes an irritant. The diet under all circumstances should be nutritious but unstimulating, alcohol being given carefully, according to the patient's powers. In all cases, however, of inflamed bladder, the Surgeon ought to remember its cause, which is generally due to some obstruction to the flow of urine or local cause of irritation; and for a cure, the removal of its cause is essential.

Ulceration of the Bladder.

On ulceration of the bladder.

This is rarely the result of ordinary cystitis, though it may occur in the paralysed organ, and is met with after death where catheterism has been frequently employed, and in cases of stone. It is likewise found in tuberculous subjects from the breaking down of tuberculous material, as well as in cancer. The disease is indicated by the same symptoms as exist in inflamed bladder, with more local distress, more blood in the urine, and greater pain after micturition. There is usually also much constitutional depression and want of power. I have seen two cases in which extravasation of urine above the pubes resulted from this disease, one of which recovered and the other died.

Treatment.

The indications for treatment are similar to those for cystitis, opium being freely used as a suppository or an enema. All mechanical interference should be avoided unless absolutely called for, and then it should be of the gentlest kind. It is a question, however, whether, in the severer forms, median perineal cystotomy would not be a sound practice, the urine would then flow away as secreted, and a chance given to the bladder to recover itself; at any rate, the operation would give relief. I have done this on several occasions with success.

Tubercular Disease of the Bladder.

This is a rare although a real affection, and is confined to young middle age. It is generally associated with the same disease of the kidneys, prostate, vesiculæ seminales, and testicles, and shows itself as a deposit of tuberculous matter in the mucous and submucous tissue, which, when it breaks down, forms an ulcer. It is usually accompanied with symptoms of irritable bladder and painful micturition, the latter symptom being more common when ulceration has taken place.

Tubercular disease of the bladder.

Rest in the horizontal posture is essential in this as in all bladder affections, anodynes, tonics, and nutritious food being of great value. My friend, the late Mr. Poland, told me that in a case of tubercular disease of the bladder attended with ulceration (which was under Mr. Aston Key's care when he was a dresser, about 1840), where the suffering was severe, Mr. Key suggested the propriety of laying the bladder open, as in lithotomy, and thus allowing the urine to flow off as soon as it reached the bladder. The patient, however, was too far exhausted from advanced lung disease to allow of its performance. Mr. Key stated that, in another case where the disease had not made so much progress, he should not hesitate in performing the operation. The bladder in this one was found almost stripped of its mucous membrane, and what remained was studded with tubercular deposits. Mr. Key called it phthisis of the bladder. At the present day Mr. Aston Key's suggestion of cystotomy would probably be performed.

Tumours of the Bladder.

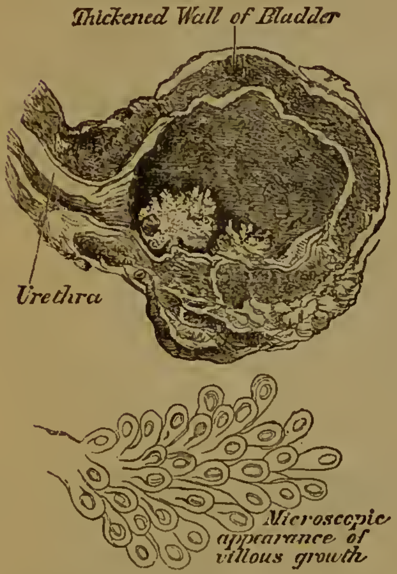
Tumours of bladder.

A bladder anatomically being constructed of mucous membrane, fibrous and muscular tissue, may be the seat of "PAPILLOMATA," the innocent "*villous growth;*" "MYXOMATA," or mucous polypus; "FIBROMATA," or fibrous growth; "MYOMATA," or muscular. Containing, likewise, as it does, epithelial and connective-tissue elements, it may be the subject of "EPITHELIAL CANCER," as well as of a "SARCOMATOUS GROWTH;" and to this list DERMOID tumours may be added. Any one of these growths may be intramural or polypoid. The papillomata are found in children, as well as in adults. The other forms of tumour belong more to the middle-aged or old. Growths are as common in the female as in the male sex.

Papillomatous.

The *papillomatous* are mostly pedunculated, villous, and single. Many are sessile and multiple. When single they are generally attached to the base of the bladder; that is, to the trigone and orifices of the ureters, when at times their long villous ends or prolongations of natural villi are carried by the urine stream into the urethra, where they may be broken off and expelled, or cause obstruction.

FIG. 322.


Thickened Wall of Bladder
Urethra
Microscopic appearance of villous growth

Villous growth in bladder, with hypertrophied walls of the organ. From drawing 368^{63}, Guy's Hosp. Mus.

In exceptional cases the mucous surface of the bladder may be more or less covered with these villous or sessile papillomatous growths; indeed, instances are on record where the ureters or calyces of kidneys were involved.

These growths are benign and of slow growth; they may last for six or more years.

Fig. 322 well illustrates the ordinary appearance of this variety of tumour, with the changes brought about in the bladder from its presence.

Fibromata.

The *myxomata*, *fibromata*, or *myomata*, are mostly single tumours, and develope as polypoid or irregular-shaped outgrowths, the expulsive action of the bladder doubtless doing much towards making the growths polypoid. They affect both sexes equally, and are more frequent during young than old life; they may grow from any part of the bladder, but generally from the trigone.

In Fig. 323 the disease was extensive. It was described by Sir A. Cooper as "Tumour of the mucous membrane of the bladder everted, polypoid excrescences producing symptoms of stone." Fibrous and myomatous tumours are, however, rare. In 1883 I had a man, æt. 60, under care with a fibrous growth springing from the fundus; it had caused symptoms for four years.

Cancers.

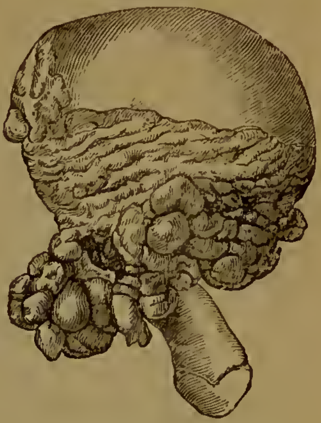
Cancer of bladder.

These are generally of the epithelial form, but examples of the hard and soft varieties have been recorded. They are generally sessile and infiltrating the walls of the bladder, but they may assume the villous shape. The affections may be primary; more commonly, in women, the bladder becomes involved by the extension of disease from the uterus, and in men from the rectum. Under all circumstances the disease is one of middle or advanced age.

In the notes of a case before me, however, the disease appeared in a man, æt. 28; in ten others the ages varied from 48 to 69.

Symptoms.—All bladder tumours give rise to much the same series of symptoms, which may be brought under three headings, namely, *irritability of bladder*, passing on to incontinence, *hæmaturia*, and *pain*.

FIG. 323.



Polypoid outgrowths from mucous membrane of bladder. Preparation 2104²³, Guy's Museum.

The irritability may be very slow in its increase, intermittent in its action, or rapidly progressive. In the majority of tumours it is the earliest sign; in the villous or papillomatous it rarely appears till other evidence of bladder trouble, such as hæmaturia, shows itself. When it has appeared it usually steadily increases in severity, till at last the bladder refuses to retain urine, and incontinence ensues.

The progress of villous disease is usually slow, but it may be rapid. Thus, in one case of villous growth, the notes of which are before me, in a man, æt. 37, the irritability of bladder and hæmaturia had been gradually increasing in severity for *eight years*, and after death the mucous lining of the bladder was found covered with a growth, and the walls of the bladder were so thickened that, when removed, empty of urine, it was as large as a cocoa-nut; whilst in a second case, which occurred in a man, æt. 70, there had been symptoms for only *two months*, and the first was hæmaturia. No pain nor difficulty in micturition had appeared till five days before his admission into Guy's. He died from suppurating kidneys. In this case the disease was localised to the trigone of the bladder.

It is to be remarked also that in villous disease there may be intervals of days, and sometimes weeks, between the attacks of hæmaturia, the urine between whiles being normal. In cancerous disease these intervals are rare.

It need hardly be said that the urine should be most carefully examined in all these cases, and its sediment and clots washed, for in one case a small fragment of villous growth may often be found in it, and in another *masses* of epithelial or spindle-shaped cells—not isolated cells, however numerous—when the diagnosis will be complete.

With the same view, when a catheter has been passed, the contents of the instrument should be well washed and examined. I have on several occasions found pieces of growth in the instrument, and in the case of a female child, who had several attacks of hæmaturia, I caught in the eye of my catheter a small villous growth, pulled it away, and cured the child.

Coagulating urine.

Ultzmann ('Villous-Ueber Hematurie,' 1878) has described a condition of urine met with in villous growths, which he considers diagnostic. It consists of a coagulating of the urine, which seems free from blood, into a glutinous mass soon after it has been passed; the mass consisting apparently of fibrine. A. Stein, of New York, in his able memoir on bladder tumours, 1881, confirms the observation. It would seem as if, in some cases, liquor sanguinis exudes from the villi, and in others blood.

Hæmaturia.

Hæmaturia, or the passage of blood-stained urine, or blood in abundance, or in clots, is a constant symptom, and in the villous growth it is usually the earliest. In such it is also very intermittent; that is, it may appear to-day, and not reappear for three or four months. The same may be said of other growths, but, as a rule, when hæmaturia has appeared with them, it is persistent. It is, however, usually a later symptom.

The blood generally shows itself towards the end of micturition, the stream of urine being at first clear, and then towards the end red. In exceptional cases, however, the blood may pass first.

The position of the growth must have much to do with this symptom, growths about the trigone being more liable to bleed when the bladder contracts than the same situated nearer the fundus.

In exceptional cases of tumour of the bladder there is no hæmaturia.

Pain.

Pain is not a constant symptom of this disease, although uneasiness from frequent micturition may be troublesome; pain becomes more marked as the irritability of bladder increases, and inflammation shows itself; and in the later stages of trouble it may become intense.

The pain is usually felt in the penis after micturition, but a dull suprapubic pain is by no means an uncommon symptom of bladder growth.

Pain over the sacrum and in the perinæum and rectum, and pains shooting down the thigh, are not rare. Lumbar pains are of frequent occurrence towards the close of the case.

Diagnosis.

Diagnosis.—From what has been said as to symptoms, it will be gathered that it is in exceptional cases alone a true diagnosis of any special vesical growth can be made out, although when hæmaturia, steadily-increasing irritability of bladder, and pain are present, and these symptoms are unrelieved by treatment, the diagnosis of a local vesical cause may fairly be made. A bimanual, vaginal, and suprapubic combined examination will often prove of great value in aiding diagnosis in women and in men. The same method applied through the rectum may be equally serviceable.

But for a completely satisfactory digital exploration of the bladder, a full dilatation of the female urethra is absolutely essential, and a central perineal urethral incision in the male, by which the membranous portion of the urethra is opened, to allow of direct digital exploration is equally called for.

Sounds and catheters are of use, but they are of uncertain value, and more particularly when compared with "direct digital bimanual exploration," as strongly advocated by Sir H. Thompson.

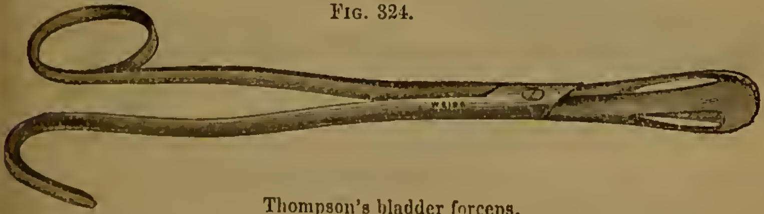
Treatment.—Little more than palliative treatment has hitherto been generally employed in these cases; as bladder tumours have been little understood. Yet an old Surgeon of Guy's, Warner, in 1747, incised the urethra of a woman, æt. 23, who was suffering from a polypus, and put a ligature round the peduncle of a growth the size of a turkey's egg with complete success; Dessault, after removing a stone from a male, successfully twisted off a polypus that he found in the bladder, and Mr. Birkett ('Med.-Chir. Trans.,' 1858), in a striking example of the disease occurring in a female child æt. 5, applied a ligature to the growth, but the patient died with suppurating kidney, the effects of the disease; and in many cases the practicability of successful operative interference is not discouraging.

I also in 1864 removed a villous growth from a woman's bladder with the écraseur with complete success. Other cases may also be found in surgical literature in which operative interference has been employed and more particularly in women. In male subjects the instances are very few. Civiale in 1827 used to crush vesical growths with the lithotrite with some success, and Covillard, according to Crosse ('Urinary Formations,' 1835), was the first to perform designedly perineal cystotomy for a tumour with success. Crosse repeated the operation in 1834, Billroth, Volkman and Kocher in 1874, Humphrey in 1877, and Davies-Colley in 1880. At the present time Thompson has ably advocated it. Suprapubic cystotomy has been employed in still fewer cases. In considering these operations it is always to be remembered that a case of bladder tumour when left to nature can have but one ending, and that is death. Every recovery, therefore, aptly writes Thompson, "is a clear gain." In all cases of persistent bladder irritation and hæmaturia in which the cause is doubtful a full exploration of the bladder in the ways previously suggested by urethral dilatation in the female and a perineal incision into the membranous portion of the urethra in the male should be undertaken.

Should no tumour be found the injurious effects of the operation may be put down as very slight. Should one be found to exist its removal will probably be effected. Thompson writes that out of 27 explorations he found and removed growths in 12 cases and that 5 of them were effectually cured.

The growth when discovered should be removed by scoop écraseurs or forceps of different shapes and sizes. Thompson uses cutting as well as crushing forceps. The latter are probably the safer and most efficient (*vide* Fig. 324).

FIG. 324.



Thompson's bladder forceps.

When the whole growth can be removed, so much the better, but should this not be possible, the Surgeon may console himself with Thompson's opinion that "a complete ablation of the growth is not absolutely essential to success; that as cicatrisation takes place, this process by degrees leads to solidification of the tissues at the point at which evulsion was made." In female subjects the operation is far easier than it is in the male. In both, however, it should be considered and adopted in any case of suspected tumour. When any difficulty is experienced in finding or removing the growth, it may be well to leave the case alone for twenty-four hours, as, from a case related to me by my friend Mr. H. Morris, it seems that when a bladder containing a growth is drained, the growth itself may be partially extruded through the wound by the natural expulsive action of the bladder, when it can be readily seized and treated.

Suprapubic operation.

Under certain circumstances a suprapubic operation might be preferable to the perineal, for example, when a growth is at the fundus or very large. In a case of my own of fibrous growth in the fundus I regretted that I had not chosen it.

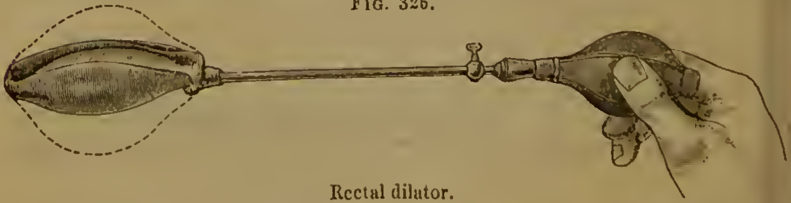
Garson's observations.

The Surgeon when considering any operation upon the bladder should remember that its position is capable of undergoing great changes; that in the adult when flaccid it lies behind and below the level of the symphysis, and that when moderately distended it may be uncovered with peritoneum for about one inch at its upper and anterior surface. He should likewise be aware of what Dr. J. G. Garson, of the College of Surgeons, has demonstrated ('Edin. Med. Journ.,' Oct., 1878) when the rectum is distended with a rubber oval bag measuring when full 10 inches in circumference (the size of a man's hand), that the bladder is raised out of the pelvis into the position it occupies in the new-born child, and that under such circumstances the bladder is uncovered above the symphysis for about three inches. It would seem by Garson's experiments that the bladder is raised out of the pelvis by stretching the prostatic portion of the urethra to nearly double its ordinary length and that with the elevation of the bladder its posterior peritoneal covering is considerably raised; Douglas's pouch, which is normally about 2½ to 3 inches from the anus, being raised to 3, 4, and even more inches. My own observations with the rectal dilator upon the cadaver support Dr. Garson's views.

The bearing of these facts upon suprapubic bladder operations is palpable.

For distending the rectum an oval india-rubber bag, ten inches in circumference, with a metal perforated tube for introducing and filling purposes, may be employed (Fig. 325).

Fig. 325.



Rectal dilator.

Dermoid tumours.

Dermoid tumours of the bladder are of rare occurrence, and when they occur they are probably ovarian in their origin, and are discharged through the bladder. In exceptional cases they may have a bladder origin, that is, may have been developed within the walls of the bladder and at a later stage broken down, ulcerated into it, and been then discharged.

In the following case this explanation seems to be the only reasonable one.

Author's case.

A married lady, æt. 30, the mother of two children, came into my hands on June 30th, 1883, to be operated upon for some hæmorrhoidal trouble; she then complained of slight bladder irritability of a few days' standing. Previous to this she could hold her water for hours, indeed, on hunting days she could do so for eight or ten. I regarded the bladder symptom as one associated with her rectal trouble.

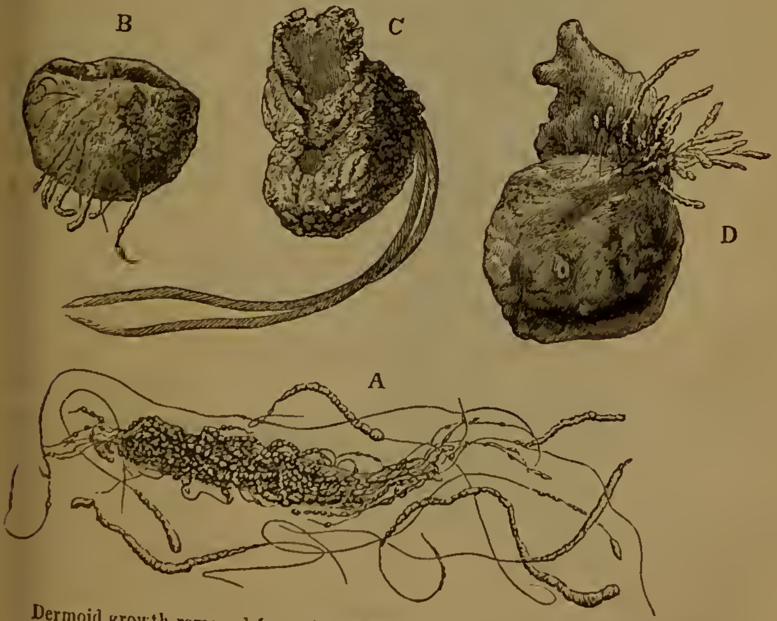
After the operation the symptoms continued, and on July 10th, without any apparent cause, intense fever and constitutional disturbance appeared, and on the 11th her bladder symptoms became intensified.

On the 12th some urethral obstruction occurred, and on examination with a view to relieve it, I removed a bundle the size of a penholder of fine hairs covered with phosphates from the urethra (Fig. 326A), which bundle is now in the Museum of the Royal College of Surgeons. With the removal of this, all constitutional symptoms disappeared. The bladder irritability however lasted, and for the next six weeks small phosphatic calculi formed on long and short hairs were being frequently passed. Some of these hairs were a foot long; the majority were, however, short.

On several occasions I washed the bladder out with relief. Early in September the patient was fairly comfortable; she could hold her urine for hours, and pass it without pain. She then left London. Suddenly, however, towards the end of the month all her severe symptoms returned, and with aggravation. The urine became charged with mucus, and likewise with blood.

Early in October I saw her again, when she was passing masses of

Fig. 326.



Dermoid growth removed from the bladder with hairs (A), covered with phosphatic concretion. (B) First part removed. (C) Pedicle with ligature. (D) Growth and pedicle finally removed.

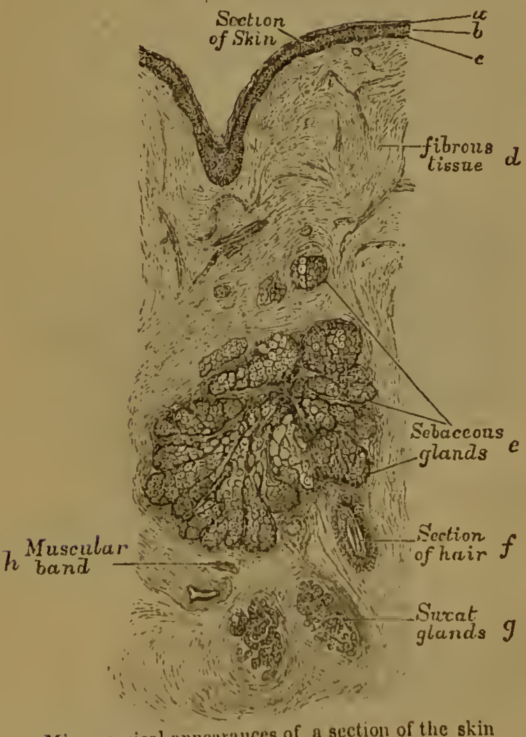
phosphatic concretion formed on hairs, with urine full of mucus and pus. A bladder exploration was then arranged.

On October 29th this was performed, Sir H. Thompson kindly assisting me with Mr. H. Morris.

For a full examination an anæsthetic was given, and the urethra rapidly dilated with the small instrument I am in the habit of using (Fig. 394). I then introduced my finger into the bladder, and at once came down upon a mass of phosphatic concretion matted on hair. This I removed, and having done so discovered hanging from the upper wall or fundus of the bladder a polypoid outgrowth about one inch and a half long, the pedicle of which apparently came out of a kind of annular depression in the walls of the bladder. These facts were likewise recognised by Sir H. Thompson. I then seized the growth with a pair of Thompson's fenestrated forceps (Fig. 324) and drew it well down, and having done so applied to its pedicle a ligature of chromicised catgut.

Sir H. Thompson then, whilst I held the growth forward, cut off its summit, which measured three quarters of an inch across (Fig. 326B). This turned out to be what it appeared at the time, a piece of coarse but perfect skin with sweat and sebaceous glands and hair follicles. A few hairs were on the surface, but the bulk of them had been removed (Fig. 327).

Fig. 327.



Microscopical appearances of a section of the skin covering the dermoid tumour.

After the operation all the bladder symptoms were relieved for a few days; they then increased, but were again relieved when the pedicle with its ligature came away on the tenth day (Fig. 326C). After this everything went on well for a few days till the catamenia appeared, when bladder troubles returned and rapidly increased, indeed they soon became as bad as ever.

On November 17th another exploration was made of the bladder, when it was found that the pedicle of the growth which had been left had much increased, and had apparently protruded as far again as ever from the annular ring in the bladder which was noticed at the first operation.

The polypus was consequently again seized and drawn down, and as Sir H. Thompson was about to apply a ligature to its pedicle the whole thing came away with the forceps in my hands. The growth removed was as large as that which existed at the first operation, and it came away pedicle and all (Fig. 326D).

After the operation the annular ring noticed was very distinct, and into this the finger was passed with ease. I need, however, hardly add that neither I nor Sir H. Thompson were too curious as to where it led.

With this operation all trouble ceased. The bladder in two days was well able to retain its contents. In three days all blood and mucus disappeared from the urine. In a week the urine was normal. At the end of two weeks from the operation with the exception of a little soreness no bladder symptoms existed, and within one month the patient was as well as she had ever been in her life. She is now as if she had never had a bladder trouble.

Remarks on case.

Remarks.—I believe this tumour to have originated from a dermoid cyst which had been implanted in the walls of the bladder during the patient's fœtal life. That it began to undergo changes in its interior a few days before she came into my hands for rectal mischief. That the tumour then acutely inflamed gave rise to the severe constitutional symptoms mentioned, and opened into the vesical cavity. That at its opening it discharged, firstly, the mass of fine long and short hairs covered with a very thin layer of phosphatic deposit, and, secondly, the innumerable larger masses or rather calculi which were subsequently passed or removed.

That for a time the cyst having partially discharged itself the bladder trouble then subsided, and when it reappeared it was from the formation of almost a calculus upon the remaining hairs which the dermoid cyst then contained.

That this cyst then began to turn inside out, and from the expulsive action of the bladder to become polypoid.

That at the first operation when the bulk of the projecting growth was removed this process was not completed, such having only taken place at the second.

Dr. Goodhart's report.

To support these views Dr. Goodhart's following report of the preparation will be read with interest. The specimens submitted to me were a rounded, knob-like piece, with a truncated end, which had been removed at the first operation, and an elongated, somewhat irregular-shaped mass, presumably the stalk from which the first piece had been removed. Both had long dark hairs growing from them in considerable numbers, and these were mostly thickly covered with a shell of yellowish phosphatic matter.

A section of the knob showed it to consist, apparently, of a layer of thickish skin, with a quantity of tough fibrous tissue beneath it (Fig. 327). The opinion furnished by the naked eye was quite borne out by microscopical examination. No lengthy description need be given of it, as a very truthful drawing of a part of the section has been made by Miss Boole, which will show at once that the growth is composed of perfect skin. At *a b c* is the epidermal layer with its horny layer at *a*, the intermediate layer at *b*, and the mucous layer at *c.*; below this comes a thick layer of fibrous tissue (*d*), which has been reduced in the drawing to allow of the introduction of the deeper part. At *e* is a sebaceous gland; at *f* a section of a hair cut obliquely, and surrounded by its cuticular sheath; while at *g* are seen sections of sweat glands.

The only question that arises from the appearances is as to the existence or not of striped muscular fibres.

In many parts of the section are broad bands (a piece of one is shown at *h*), which look very much like muscular fibre, but the striation is nowhere distinct enough to pronounce with any certainty. I am inclined to regard them as an embryonic form of muscle midway between the striped and unstriped varieties. But however this may be, the nature of the growth is clearly similar to what upon the surface of the body would be called molluscum fibrosum; that is to say, a polypoid overgrowth of the corium and subcutaneous tissue, covered by the epidermal layers.

In the urinary bladder, naturally the first, and, indeed, the one question is, how such an excrescence could get there, and I believe that only one answer to that question has any degree of probability attached to it.

It has been suggested that it is some congenital growth like a hairy mole upon the skin; but, taking into account the history, which conclusively establishes that the patient was perfectly free from any vesical trouble of any kind until recent date, and knowing that hair in the bladder always provokes a deposition of phosphates, and causes extreme worry and cystitis, it is inconceivable that this growth has been in the bladder any length of time. It must, therefore, have come from the outside. The history, again, points strongly towards this conclusion, for the first symptoms were those of high fever, and subsequent cystitis. I take it, therefore, as probable that at that time some inflammation occurred around this growth, situated outside the bladder; that ulceration occurred in the bladder, and the polypus escaped into the cavity, and that, when once there, it immediately provoked, as such a growth might be expected to do, the intense cystitis that then happened.

When we further have to decide whence the growth sprang the facts of the case are, I think, quite unmistakable; for before the growth had been detected a mass of hair had been discharged from the bladder, with a quantity of phosphatic matter (? fatty matter). This surely indicates that a dermoid cyst had opened into the bladder, and the growth in question was no doubt a sprout from its wall. Whether the dermoid cyst sprang from the ovary, as is naturally *most* probable, or came, as is not unknown, from some other part of the pelvis, there is no evidence in the preparation to determine.—JAMES F. GOODHART.

Atony of the bladder.

Atony of the bladder

is a want of muscular power in the bladder to expel its contents, as a result of over distension from either compulsory retention, or organic obstruction, or from some cerebral disturbance or from fever, &c. It has been often falsely described as paralysis of the bladder, but, whereas in paralysis the loss of power is due to a want of nerve supply, in atony it is the result of want of muscular power due to exhaustion or over-stretching. It may be associated with retention or with incontinence, the latter condition showing itself when the bladder is over-charged, the dribbling of urine being a mere overflow.

Treatment.

TREATMENT.—As the cause of atony of the bladder is muscular exhaustion, so the treatment consists in giving the organ muscular repose, which can be done by catheterism. Where the atony is not very complete, the drawing off of the urine twice a day may suffice to allow the organ to recover its tone, and to act naturally. But when the atony is extreme, it may be necessary to introduce a catheter into the bladder and to fasten it there, the urine being allowed to run away as secreted through a tube fixed on the end of the catheter. By this means the most complete rest can be given to the organ. Where the bladder is sluggish in resuming its functions, tonics such as iron may be given, with the local injection into the bladder of some stimulant, as cold water, diluted nitric acid or tincture of iron in the proportion of four to ten drops to the ounce; but catheterism alone, as a rule, is enough; these cases generally recovering unless the cause has been acting for too long a period. When recovery is slow, an electric shock through the pelvis is often beneficial.

Paralysis of the bladder.

Paralysis of the bladder is a far more serious affection than atony, since the want of power is due to deficiency in nerve supply, which deficiency may be partial or complete. It is met with whenever the spinal cord is injured or diseased, as in brain shocks or disease, in reflected irritation from disease about the rectum, uterus, &c., and after any operation upon these parts. It may be caused also by a severe mental shock, or the general depression from a fever.

Treatment.

TREATMENT.—The cause of the paralysis in these cases must always have an important influence on the practice of the Surgeon, but the necessity of keeping the bladder empty is essential under all circumstances; for this purpose a soft, full size elastic catheter had better be passed two or three times a day, the greatest gentleness being observed in the manipulation. When anything like cystitis is present it should be locally treated by washing out the bladder, &c., as already indicated. To leave a catheter in the bladder is not desirable. When professional aid is not always at hand, a nurse may at times be entrusted with a full-sized vulcanised india-rubber catheter without a stilette, and allowed to pass it; it has simply to be pushed down the penis, and can do no harm. In fever cases the plan is a good one.

Hysterical retention.

Hysterical retention is not rarely met with in women, and is difficult to treat. Catheterism is only to be resorted to when necessity compels; hysterical patients usually micturating when the pain of retention calls loudly for relief. The cold douche over the lower part of the abdomen is a good local remedy for the affection, and not too pleasant for the patient to wish for its repetition. Moral treatment is always called for in these cases, and is more needful than surgical interference.

Vesico-intestinal Fistula.

On vesico-intestinal fistula.

This is sometimes met with, and it is probable in the majority of cases that the ulcerating process commences in the bowel and involves the bladder in a secondary way. It usually first manifests its presence by the passage of wind with the water, some little irritability of bladder having previously existed; fæces, liquid or solid, soon follow, giving rise to fetid urine and severe bladder symptoms, the pain of foreign material in the bladder being very marked when the large intestine or rectum is involved; the liquid motion of the small intestine does not appear to give rise to the same local distress as the solid.

Symptoms.

Diagnosis.

There is no difficulty in recognising this mixture of urine and intestinal contents. When flatus passes per urethram the condition may be suspected; when the urine has a fæcal odour and colour the condition gives rise to something more than a suspicion; and when solid fæces are visible the diagnosis is certain. In doubtful cases the microscopical examination of the sediment of the urine will readily reveal its nature. At times the fæces may obstruct the urethra and cause retention.

In looking into the history of these cases there will usually be found some bowel symptoms, some diarrhœa or dysenteric affection, some symptoms of stricture or cancer of the bowel; and, although this affection may be found associated with cancerous disease, it seems more frequently to be the result of the simple perforating ulcer of the bowel.

Treatment.

TREATMENT.—When a fæcal fistula has once formed between the bowel and bladder, the hopes of an unaided natural cure are very feeble; when solid motions are mixed with the urine, but little can be done except by an operation to palliate the suffering that is produced. For a time the bladder may be emptied of its contents, and, by being washed out, freed of its local irritant; but the truce can be only for a limited period, another action of the bowel being to a certainty followed by a fresh entry of fæculent material into the bladder with all its evil effects.

When liquid motions or small intestine contents communicate with the bladder the symptoms are not nearly so distressing, and the necessity for interference is thereby diminished.

Colotomy advised.

The only means the Surgeon has at his disposal by which relief can be afforded is colotomy; and, when the rectum is the seat of the disease, whether cancerous or otherwise, lumbar colotomy ought to be performed. By it the fæces are diverted from their unnatural channel and discharged through the loin, and all the miseries of bladder complication are effectually relieved. When the ulceration is of a simple kind, there is some prospect of its closing; when of a cancerous nature, such a result cannot be expected; but, under both circumstances, a large amount of relief is immediately afforded and life prolonged.

Examples.

I have had four cases of vesico-intestinal fistula, in which this operation, lumbar colotomy, has been performed with marked success; one lived six years after the operation, and died, æt. 70, from ruptured heart; the second is still alive and well, eleven years after the operation; the third died four months after the operation from kidney disease. Mr. Holmes, Mr. C. Heath, and Mr. Pennell, of Rio, have had similar cases. For further information *vide* Holmes's paper, 'Med.-Chir. Trans.,' 1866-7; and case, with remarks, by author, 'Brit. and Foreign Quarterly,' Jan., 1869; and 'Clin. Soc. Trans.,' 1872.

Incontinence of urine.

Incontinence of Urine

is met with under two very different conditions. In the one, during sleep, when the will of the patient is in abeyance—the neck of the bladder ceasing to act from want of power, and giving rise to *nocturnal incontinence.* In the other, the incontinence is only *a result of over-distension,* and is a mere overflow. The first form is common in children, the second in adults. Incontinence, however, both in the child and adult, may be due to bladder irritation from the presence of a stone or other foreign body, and it will then exist during the day, rather than at night. It may also follow the operation of lithotomy from injury to the sphincter of the neck of the bladder.

Causes.

Incontinence in the child.

Incontinence in the child is a very troublesome, and often very obstinate affection. It is, notwithstanding, generally curable, and even in very bad cases, as puberty approaches, the symptom disappears, though in exceptional instances, the infirmity continues in after-life. The child is generally brought to the Surgeon because he "wets his bed," when too often the history reveals the painful fact that punishment has been severely tried before professional advice was sought; and it is needless to add that by such a process, no cure can be effected. In many instances, the habit is in a measure induced by a want of attention in the parents to take the child up during the long hours of the night.

Treatment.

When the prepuce is very long or adherent, circumcision should be performed.

When the urine is chemically wrong in any of its constituents, remedies must be given to correct the faults, and a limpid watery urine in a child, as in an adult, is always an irritant.

With respect to medicines, the tincture of iron is doubtless the best, and next to it belladonna, either in the form of the tincture or extract, but in some instances the combination of the two is excellent.

I have tried and been disappointed with full doses of chloral given at bed-time. It acts at times wonderfully well, but at others appears useless. When employed, it should be given on an empty stomach. Tonics are the right medicines, one form often succeeding where another fails; iron, quinine, nux vomica, and zinc being, as a rule, better than belladonna. The tonics by day and a night-dose of belladonna have sometimes proved of value.

The bowels should always be attended to, and the presence of worms considered; and it is well to have the bowels relieved at night before going to bed. When the child is not too young, cold baths with or without salt should be used, and every means should be employed to maintain the general health, although it must be added, that children who labour under this infirmity are rarely feeble and cachectic. The child should be encouraged to sleep on its side in preference to his back, and for this end, a hankerchief with a knot in it may be fastened round the pelvis, the knot being adjusted over the sacrum.

Dr. W. Steavenson records ('Brit. Med. Journ.,' January 6, 1883) cases of frequent micturition treated by electricity with the most beneficial results. In these, one electrode, in the form of a spinal disc, was connected with the positive pole of the battery, and applied to the lumbar region; and the other electrode was applied above the pubes or to the perinæum; through these a weak current was passed for a few minutes daily. Relief of the symptoms, from the commencement of the treatment and by complete cure, usually within a fortnight have been the results.

In cases of extreme obstinacy, some Surgeons apply a solution of nitrate of silver, ten grains to the ounce, to the neck of the bladder, and it is said with advantage. Others apply mechanical means to prevent the flow of urine, such as an india-rubber ring around the penis, or cover up the urethral or preputial orifice by a layer of collodion. Good reports have been given of these practices. I cannot say that I think well of any such means and have never adopted them, as they seem wrong in principle.

Nocturnal incontinence in a child generally means atony of the sphincter; while incontinence during the *day* suggests bladder irritation, generally a stone or urethral obstruction.

Incontinence in adults.

Incontinence in the adult, as already stated, means, as a rule, overfulness of the bladder, the real condition being one of retention from some obstructive urethral or prostatic disease, bladder atony, or paralysis. It may, however, be due to stone, or to a preceding lithotomy. In women, it may be associated with some uterine displacement or disturbance, some urethral disease or injury. In men and women, severe spine disease may cause it. To treat it, the cause must be ascertained, and the introduction of a catheter is probably a sound practice to follow as the first means of investigation, since it settles at once the question of retention, and often detects the true cause, thereby giving a clue to the treatment to be adopted, viz. the removal of the cause.

Treatment.

True incontinence, however, is met with in severe cases of general or local paralysis, in functional derangement of the cord from venereal excesses, and still more frequently from self-abuse; such patients often complaining of "inability to stop the flow of urine when commenced." It is, however, seen in old people with prostatic enlargement, the third lobe being enlarged and projecting forward between the lateral lobes, so as to open out the neck of the bladder and render it constantly patent, the incontinence being due to overflow, the result of retention.

In these cases the use of a urinal is the only remedial means at the Surgeon's command, except in those caused by venereal excesses, when tonics, cold bathing, and absolute abstinence from all injurious habits may effect a cure.

DISEASES OF THE PROSTATE.

On diseased prostate.

The diseases of the prostate gland are of importance. Placed as the gland is at the neck of the bladder and at the commencement of the urethra on the one hand it may suffer as a consequence of urethral disease, and on the other, when diseased, it may give rise to bladder symptoms of considerable severity. Thus, as a consequence of urethral disease, gonorrhœa, or stricture, it may inflame or suppurate, and mechanically interfering with the flow of urine, cause retention. It may, indeed, undergo nearly complete destruction from suppuration, the direct consequence of stricture, and possibly of extravasation. When enlarged from hypertrophy, stone, cancer, or any other cause, it may mechanically interfere with the flow of urine, and so give rise to bladder symptoms or bladder disease of no slight severity, and later on cause incontinence from overflow by the special direction of the growth.

Inflammation of the Prostate.

Inflamed prostate.

This is usually due to the extension backwards of a gonorrhœal inflammation, or to the presence of a stricture. It may arise, too, as a complication of cystitis from the irritation of a calculus, the passage of a sound, or the application of caustics. It is also not unknown as an idiopathic affection in gouty subjects, and in those who indulge in sexual excesses.

Symptoms.

It is generally ushered in with pain in the perineum and bladder irritation, the act of micturition being attended and followed by pain, and often tenesmus. Defæcation ceases to be a painless act, and is attended with uneasiness, sometimes with difficulty, and at last with distress. On manipulating the perinæum a deep-seated fulness will be felt, and on passing the finger into the rectum the prostate will be found enlarged, spongy, and painful; rigors probably will form one of the general symptoms with febrile disturbance, which will vary in severity according to the acuteness of the affection.

Abscess forms.

If the inflammation advances to abscess a throbbing pain at the neck of the bladder will be felt, with a constant desire to go to stool, and retention of urine is almost sure to occur.

If left alone, the abscess will probably burst into the urethra and discharge itself externally with immediate and marked relief; while in other cases it may open into the rectum. It sometimes happens that the abscess is ruptured during the passage of a catheter to relieve retention, or during a rectal examination.

When the disease is *acute*, the local as well as the general symptoms will be severe; but when *chronic*, they will be less marked, though not less characteristic.

Chronic prostatitis.

As a result of acute inflammation, *chronic disease* is often left, as indicated by pain in passing water, irritability of bladder, a thin urethral discharge, cloudy purulent urine, and perineal, pelvic, and anal pain, which is increased on exercise or excitement. There may be at times some little loss of power in emptying the bladder, pain in sexual intercourse, or frequent nocturnal emissions.

Treatment of prostatitis.

TREATMENT.—When the symptoms are acute few remedies give more relief than the application of fifteen or twenty leeches to the perinæum, followed by a hot hip bath, and the subsequent application of a linseed poultice made with the decoction of poppies or mixed with the extract of opium. A good purge should also be resorted to, and alkalies given with sedatives, such as morphia or opium, allay pain.

With retention.

When retention of urine complicates the case, a catheter must be passed, a catheter coudé being the best, but the warm bath and opium should first have been employed, as the introduction of a catheter under such circumstances is always painful, and may do harm. When required, an elastic instrument, which has been well softened and oiled, should be selected. Rest in the horizontal posture should be observed, and liquid diet given.

With suppuration.

When an *abscess* has formed, and there is evidence of deep-seated perineal suppuration, an incision in the median line of the perinæum should be made; and, indeed, if suppuration has not taken place, the operation, by lessening tension, will be followed by relief to the symptoms.

When the abscess has opened naturally, no surgical interference is usually required, although in exceptional cases, where one abscess is followed by another, and the deep parts about the gland, instead of undergoing repair, are becoming more involved, a perineal incision should be made. When the suppuration is the result of a stricture, and has probably been caused by extravasation, the propriety of dividing the stricture and laying open the perineum down to the prostate cannot be questioned.

Treatment in chronic prostatitis

In chronic inflammation, whether the sequel of the acute or not, when attended with suppuration, the practice already advised should be followed. When no suppuration exists, but only enlargement, counter-irritation, by means of small perineal blisters, is of great use, and the elevation of the pelvis with a pillow at night, is also valuable. Tonics, as a rule, are required, with the iodide of potassium. The bowels should never be allowed to be confined, the best laxatives being some saline medicine, or one of the natural mineral waters, such as Vichy or Pullna. All mechanical interference with the prostate should be avoided, and the nocturnal emissions treated on general principles, and not as being due to a local cause; tonics, generous living, and fresh air doing more towards hastening recovery than anything else. Over-exercise must be avoided, and sexual excitement forbidden.

Abscess about prostate.

Abscesses occasionally occur around the prostate, and give rise to very many of the same symptoms as a prostatic abscess. They are more apt, however, to make their way towards the posterior part of the perineum into the ischio-rectal fossa. As soon as they are recognised they should be opened by one or two deep incisions in front of the anus on either side of the median line. On one occasion I let out, by two incisions, about a pint of pus that had accumulated in this part, and produced complete retention of urine for several days. Immediate relief and a good recovery followed the operation.

Hypertrophy of the Prostate.

Hypertrophy of prostate.

This is a general term applied to a chronic enlargement of the gland which is not inflammatory, but is generally believed to be a common consequence of old age, indeed, it has been regarded as part of a general senile change. Pathological investigations, however, have taught us that although this is an affection of advanced life, it is in no way a necessary attendant on old age, the vast majority of old men having nothing of the kind.

When present, it is usually met with in subjects over sixty. Thompson has not met with an example under the age of fifty-four; and after many dissections of the prostates of elderly men he found an appreciable enlargement of the organ in one third of the cases, but in only one third of these was it enough to cause symptoms during life.

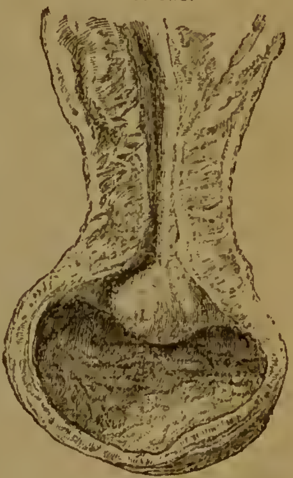
Pathology.

The disease is generally believed to be an hypertrophy or overgrowth of natural tissues, and, in a certain proportion of instances this is doubtless the case; but in others, the enlargement is clearly caused by the development of distinct glandular tumours embedded within the structure of the gland which may be squeezed out of the organ upon division of the tissues covering them in. They are sometimes merely covered by the capsule of the prostate, while at others, they are well placed within its structure; at times they are single, at others multiple, and rarely give rise to any other than mechanical symptoms. When these growths are situated in what is called the third lobe of the prostate, they give rise to symptoms of obstruction and bladder irritation, precisely similar to those caused by the genuine enlargement or hypertrophy of the gland itself. These fibrous or glandular tumours are analogous to those found in the uterus. This hypertrophy is now known to be, as shown by Ellis and others, a mere increase in the natural fibrous, muscular, and glandular structure of the organ. The enlargement is mostly general, and, as long as the vesical or third lobe is not materially enlarged, nor the urethra encroached upon, it is extraordinary to what a size the prostate may attain without giving rise to any special symptoms. It is indeed only when the so-called third lobe increases bladderways, and interferes mechanically by its size or the direction of its growth with the act of micturition, that any marked symptoms are produced. In the preparation from which Fig. 328 was taken this condition is well shown.

Glandular tumours.

Enlargement of middle or third lobe.

Fig. 328.



Enlargement of the third lobe of the prostate, with dilatation and hypertrophy of the bladder.

Effects of an enlarged prostate.

The effect of an enlargement of the prostate upon the urethra is very variable. At one time the prostatic urethra will be elongated to twice or more its normal length; while at another, it will be tortuous—this condition being caused by an unequal enlargement of the lateral lobes. In a third class the urethra will be more or less obstructed. In the bladder, other changes are found, and the sudden projection upwards of the vesical or third lobe is the most common; yet when with this there is an enlargement of one or other of the lateral lobes a great irregularity of the urethra is the result.

This enlargement of the prostate may so derange the course of the muscular fibres about the trigone of the bladder as to produce a bar or ridge that mechanically interferes with micturition. Guthrie and Mercier have described such a bar as occurring independently of these changes, the bar consisting of the elastic structure and mucous membrane of the neck of the bladder. Thompson also asserts that, in "very exceptional instances, the bar is undoubtedly to be met with." I have never known such a bar as that last described, and give it only on the authority of the names quoted. It is said to occur earlier in life than prostatic enlargements, and to give rise to similar symptoms.

Hypertrophied prostates are sometimes met with, measuring four inches in diameter, and are common at half that size. They have been found to weigh ten or twelve ounces, the normal weight of the prostate being four and a half drachms.

Symptoms of enlarged prostate.

SYMPTOMS.—So long as the vesical orifice of the urethra is not mechanically encroached upon, prostatic enlargement may proceed to an extreme degree without giving rise to any definite symptoms, and retention of urine is very often the first feature that attracts notice. But, under these circumstances, it generally will be found that the patient has had for some time a difficulty in micturition; that the bladder has hesitated to contract when the desire to pass urine manifested itself; and that either there has been less force in the expulsion of the fluid than formerly, or, that the water has flowed in a more languid stream.

Irritability.

Irritability of the bladder will generally be present, the act of passing urine being rapidly followed by the desire to do so again, and the difficulty of the act gradually increasing.

As the disease progresses, a feeling of weight and fulness in the perinæum and of irritation about the rectum will soon appear; the rectal irritation and the irritability of bladder increasing equally, till at last the two acts of defæcation and micturition take place together, the violent straining and tenesmus giving rise to prolapse of the rectum or piles, and leading the patient to believe that the bowel complication is the cause of his disease, if not the disease itself.

Cystitis.

At a still later period and as the result of the bladder being unable to empty itself, a residuum of urine remains behind, and the bladder consequently gradually expands from its accumulation, and becomes exhausted by its ineffectual expulsive efforts. The urine, moreover, at the same time, decomposes and acts as a direct irritant to the mucous membrane of the bladder. In this way, inflammation of the bladder, and subsequently incontinence from the overflow of a distended organ, is produced, this inconvenience existing day and night.

Its ultimate effects.

The ultimate result of this affection left to nature is the same as that of all obstructive urethral diseases; from the pressure of retention the bladder suffers first, and subsequently the ureters and kidneys; organic renal disease is thus set up, and the powers of life are gradually sapped by exhaustion, death being often hastened by severe bladder symptoms, hæmaturia, or uræmic poisoning.

Physical examination.

A physical examination of a patient labouring under this disease will probably reveal a bladder more or less distended; and the passage of a catheter, even after the patient has to the best of his belief emptied his bladder, will prove the presence of several ounces of urine, which may be ammoniacal; this change in the urine being produced by its partial decomposition from its retention, and admixture with the mucus of the bladder. In neglected cases the urine will be fœtid and may contain blood. The passage of the catheter will also reveal the nature of the obstruction at the neck of the bladder.

Rectal examination.

On passing a finger into the rectum the enlarged prostate will be felt, and in some cases may nearly fill the pelvis. When pus or fluid exists, fluctuation will be detected, and when inflammation, pain. To make this examination nicely, the finger should be well anointed, and, at the moment of its introduction, the patient should be told to bear down. It should be remembered, however, that to appreciate any abnormal condition of the gland, it is necessary to be familiar with its normal state.

As a consequence of this affection, and of the change produced in the urine, a phosphatic calculus may form, but its presence is often masked by the symptoms of the disease. When, however, there is increased pain after micturition, pus and blood in the urine, and extreme pain in the penis, a calculus may be suspected, and when fragments of phosphatic deposit pass, the suspicion is confirmed. In all long-standing cases of prostatic disease with bladder symptoms the presence of a stone should be suspected, although when present it is often difficult of detection, from being protected by the enlarged prostate, behind which it usually lies.

May lead to calculus.

A patient with enlarged prostate is liable to retention from any sudden chill, over-distension of the bladder, mental emotion, or fatigue; indeed, such accidents usually reveal the presence of the affection.

TREATMENT.—Medicine has no influence in checking the progress of this disease, nor in causing absorption of the enlarged organ; but surgery can do much in the way of palliating the symptoms that are the direct result of the enlargement, and neutralising its evil effects.

Treatment of enlarged prostate.

The most essential point is to ensure the complete evacuation of the bladder's contents, and also to see that no residuum of urine remains in the bladder to irritate the organ and decompose, thereby setting up cystitis. This should be done by the passage of a catheter. In early cases, where but little bladder irritation exists, the passage of the instrument once a day may suffice; but when the residual urine is in any quantity, and the bladder has lost some of its power of contraction, the introduction of an instrument two or three times in the twenty-four hours may be necessary, and in worse cases, where the bladder has lost all power of contraction on account of its over-distension from chronic retention, it may be necessary or expedient to tie a catheter in the bladder and leave it there for a time. The Surgeon must remember, too, that instrumental aid, though valuable, is a necessary evil, and should not be resorted to more frequently than the necessities of the case demand.

Instrumental aid.

Where instruments are required, a flexible full-sized catheter is the best. When silver instruments are employed, one with a large curve should be selected, the back of the catheter riding more readily over the enlarged vesical or third lobe of the prostate than a shorter one. To assist in the introduction of any instrument into the bladder, the passage of the index finger of the Surgeon's left hand fully into the rectum is an excellent aid, and, under all circumstances, the pelvis of the patient should be well raised on a pillow.

Catheters to be flexible and full-sized.

When an elastic instrument is used, and some difficulty experienced in riding over the obstruction, success may often be achieved, as soon as the end of the instrument has reached the vesical end of the urethra, by the withdrawal of the stylet with one hand and the pressure of the catheter into the bladder with the other. Force should never be employed, gentle manipulation and care almost always sufficing to secure success.

No force to be used.

When the disease is chronic, and the necessity of catheterism is probably permanent, the patient should be taught to pass a gum elastic catheter for himself; a few lessons and a little confidence being all that is required for the purpose.

When the bladder from over-distension has lost all power, and it is necessary that it should have complete rest, to allow it time to recover its tone, a catheter may be fastened in, and, if the instrument sets up much bladder irritation, a good compromise may be found in the practice of leaving it in at night, and removing it during the day. When the introduction of the instrument is attended with great difficulty, it may be expedient to leave an instrument in for some days, but, under these circumstances, the bladder should be washed out through the catheter daily.

When catheter may be left in.

The vulcanised india-rubber catheter is a good form to employ for this purpose, although at times it causes more urethral irritation than the gum elastic. A winged or other self-retaining catheter may be employed when difficulties are experienced with keeping in the simpler form.

May require puncture per rectum.

When retention is present and catheterism impossible, the Surgeon may be called upon to puncture the bladder per rectum, or to aspirate it above the pubes, in order to give relief. When severe cystitis exists, and the agony of catheterism becomes unendurable, a clean perineal incision into the membranous portion of the urethra, and the introduction into the neck of the bladder of a soft catheter, to enable the urine to flow away as secreted, is a desirable measure.

Perineal cystotomy.

General treatment.

With the local treatment of this affection, the general must not be neglected, although in importance it is quite secondary. When cystitis exists, it must be treated upon the principles previously laid down. The general condition of the patient must be maintained by means of good diet and sufficient stimulants. The skin should be kept warm and all sudden chills avoided; the bowels kept open, but not loose; pain should be relieved by sedatives, and sleep secured by hypnotics; tonics are often called for, the preparations of iron being as a rule the best.

Exercise should be taken when there is no inflammation of the bladder or other reason to forbid it, walking and driving being the best forms, and, under these circumstances, the local distress from the affection may be rendered very light, and life prolonged for many years with comfort.

Patients with this affection should once a day, as a matter of habit, pass urine on their hands and knees; the bladder in this way having more power to evacuate its contents, and the mucus and other more solid contents, which otherwise would lie behind the prostate, are got rid of with greater certainty.

On atrophy of prostate.

Atrophy of the prostate is often found in the aged and in the young; and in rare cases it is due to some arrest in its development. In the majority, it is genuine atrophy or fibroid degeneration, probably caused in some by syphilis. Such a condition, however, does not give rise to any symptoms by which it can be recognised during life, nor is it a cause of any distress.

On calculi of prostate.

Calculi of the prostate are not rare, and may be found embedded in the organ as small stones varying in size from a grain of sand to bodies of much larger dimensions. They are often very numerous, are sometimes amorphous, but generally laminated. Wollaston says they are composed of 84 per cent. of phosphate of lime, ½ per cent. of carbonate of lime, and 15 per cent. of animal matter.

Mode of formation.

"The prostate gland, like other glands, is liable to an inspissation of its secretion, producing small yellow, sometimes red, pale or colourless bodies, scattered throughout the follicular structure. These, at first, are said to consist entirely of organic matter, which Virchow believes to be derived from a peculiar insoluble protein substance mixed with the semen; but sooner or later, these formations are believed to irritate the mucous membrane, causing phosphatic depositions which become encrusted upon the organic matter, and thus the genuine prostatic calculi are found."—*Poland.*

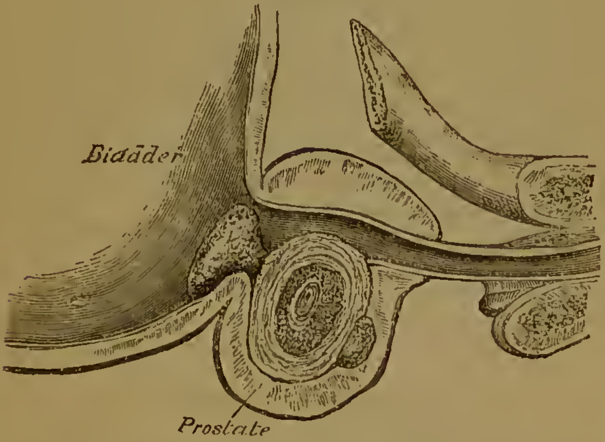
Symptoms.

When embedded in the organ and not interfering in any way with the urethra, they cause no symptoms; when encroaching upon the urinary passage, they may cause obstruction, but certainly must give rise to urethral and, probably, bladder irritation. They are accompanied occasionally by ulceration and suppuration of the surrounding parts.

Calculus may extend into bladder.

A prostatic calculus may project into the urethra and increase, the urethral portion subsequently extending backwards into the bladder and forming a prostato-vesical calculus. In 'Guy's Hospital Reports' for 1857, a case reported by Poland, with references to others, will be found (Fig. 329). The calculus has a dumb-bell shape. In all these cases, the urethra is usually pervious; the passage of a sound, however, as a rule, detecting its presence—a grating sensation being experienced in the passage of the metal instrument over the stone, but no ring will be heard. A large prostatic calculus may also be felt per rectum.

FIG. 329.



Prostato-vesical calculus.

Treatment of calculus of prostate.

TREATMENT.—When a prostatic calculus gives rise to sufficient symptoms to indicate its presence, and by its size is likely to prove troublesome, it should be removed by a perineal section—by such an operation as median lithotomy, the incision stopping short of the bladder, when the stone does not involve it. In this way, Dr. Barker (*vide* Druit's 'Vade Mecum') removed a large stone nearly five inches in diameter with success. When the stone, or stones, give rise to few symptoms of importance, they should be left alone; occasionally they pass naturally per urethram. The greatest argument against operation unless absolutely essential is found in the fact that these calculi are mostly multiple, and often exist in both lobes of the prostate.

Cancer of prostate.

Cancer of the prostate occurs but seldom, and is generally of the soft kind; indeed, as Dr. Walshe stated in 1846, "the evidence of the occurrence of true schirrhus of the prostate is defective." The symptoms are those of enlargement, and increase rapidly in severity, the disease being attended with more frequent and profuse hæmorrhage than the ordinary hypertrophy. The blood follows the straining which attends the act of micturition, and appears as pure blood; after catheterism it is often profuse. The disease may be primary, but is commonly secondary. It cannot exist for any time without giving rise to glandular enlargements in the groin or along the iliac vessels, when, as a rule, the patient's powers rapidly yield.

Symptoms.

Treatment.

The *treatment* is only palliative, the Surgeon dealing with symptoms. All instrumental interference should be of the gentlest kind, and as little as possible. Pain must be relieved by opium, and the general powers maintained by good nourishment and stimulants.

Tubercle of prostate.

Tubercle of the prostate probably, as a rule, only occurs as a part of a general tuberculosis; and until the deposit is breaking up, or by its presence is producing some suppurative action, it gives rise to no symptoms by which it can be recognised. It is too often associated with renal or bladder disease, and the local prostatic mischief is lost in the more general affection. It is quite possible that some of the cases of so-called idiopathic abscess of the prostate are the result of the breaking down of this deposit, but there are no clinical data to enable the Surgeon to diagnose the presence of this disease, and there are, consequently, none other than general rules of treatment to be mentioned.

CHAPTER XXII.

STONE IN THE BLADDER AND ITS TREATMENT.

Condition of healthy urine.

Before passing to the subject of stone in the bladder it appears desirable to consider, though briefly, that of urinary deposits, organic and inorganic; as the value of a sound knowledge of what the urine may contain, either in *suspension*, *solution*, or *precipitation*, is as indispensable for successful practice to the Surgeon as to the physician.

The student should remember that healthy urine is a clear, acid, amber-colour fluid, with a specific gravity of 1020 to 1030; that in 1000 parts, 954·81 consist of water, 45·19 of solid matters. These solid matters are made up as follows: urea, 21·57; uric acid, 0·36; extractives, such as creatine, creatinine, xanthine, hippuric acid, ammonia, sarcine, pigment, unoxidised sulphur, phosphorus, mucus, &c., 6·53; chlorine, 4·57; sulphuric acid, 1·31; phosphoric acid, 2·09; potash, 1·40; soda, 7·19; lime, 0·11; magnesia, 0·12. He should further remember that, after drinking, or after a meal, the urine is altered by the nature of the diet, and probably diluted; and that the best sample of urine to examine is that passed in the morning before breakfast—the "urina sanguinis" of Prout; when this urine contains any ingredient in excess or in deposit, some important derangement of the system exists. When any of the constituents of the urine are in excess, the balance which normally exists between them, and that keeps them in solution is disturbed, and, as a consequence, some deposit takes place. When this excess consists of the *saline* matter of the urine, such as those of potash or soda, urinary deposits and stone are less liable to form, on account of their solubility, than when the excess is found in the alkaline earths, for the salts of lime and magnesia are most insoluble, and consequently, when in excess, soon show themselves as gravel or calculi. For the same reason, uric acid being very sparingly soluble, is a very common urinary deposit, and is a constituent of most stones. When blood or pus is found in the urine, the Surgeon has to discover its source. Is the origin of the blood urethral, prostatic, vesical, or renal? Has the pus been secreted by the bladder, or been poured into it from the kidneys or other part of the urinary tract? Is the salt the result of some excessive supply of its chemical constituents, some deficiency in the working power of the machinery of the body, or some accidental circumstance? Are the kidneys themselves at fault? or is it that they are called upon to excrete morbid products which have accumulated in the blood from organic or functional disturbance of other portions of the body upon which the existence of healthy blood depends? All these points have to be determined in dealing with any case of urinary deposit; and in the special works devoted to the subject can be found all that is necessary to guide the student.

Disturbance of normal balance.

What I seek to impress here is, that urinary deposits are not themselves diseases, nor to be dealt with as such. They are always to be accepted as indications of disease, functional or organic, in some of the working organs or other parts of the machinery of the body.

Deposits indicative of abnormal action.

The reader is referred, for all special information on these points, to the works of Bird, Beale, Owen, Rees, Pavy, Bence Jones, William Roberts, Thudichum, Vogel, and Hassall.

Healthy urine ought to be quite clear. It may, however, be slightly hazy from mucus, or from the deposition of urates in cold weather, without being abnormal. When any deposit has been merely suspended in the urine, it will commence subsiding as soon as the urine has passed. These deposits are mostly organic, and derived from the kidneys themselves or urinary passages. They may consist of *epithelium-cells*, columnar or tesselated, from those parts, with more or less mucus. (*Vide* Fig. 330.)

Epithelium cells.

Blood-corpuscles or *clots*, crystals of hæmatin, or *pus-cells*, may be found.

Renal casts.—Waxy, granular, oily, bloody, or purulent. (Fig. 331.)

Renal cysts.

The urine, under all these circumstances, is albuminous, and the best tests for albumen are the following:

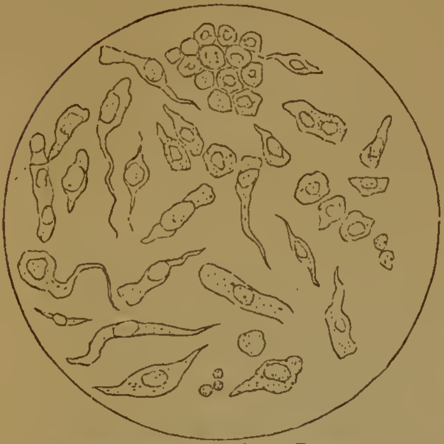
Nitric Acid Test.—To test for albumen the urine should be boiled, and enough strong nitric acid added to give the resulting liquid an acid reaction.

Any precipitate remaining after this treatment must be albumen.

Tests for albumen.

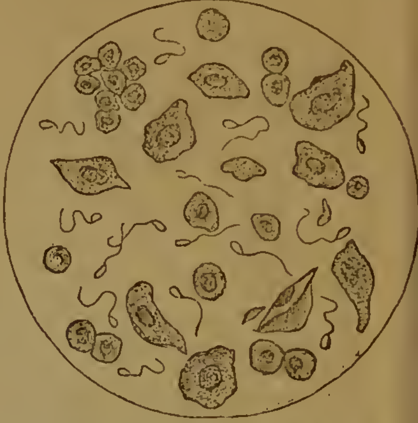
A delicate mode of employing this test is to place a few drops of nitric acid in a tube, and then pour the urine carefully upon it, so that

Fig. 330.



Epithelium from urinary Passages.

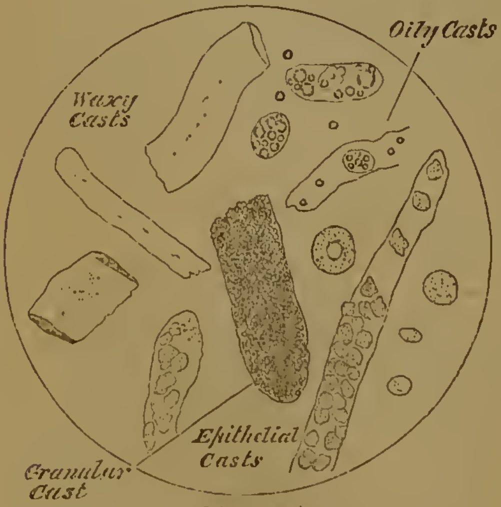
Fig. 330a.



Spermatozoa and vaginal epithelium.

the two liquids do not mix, or the reverse process may be adopted. If albumen is present an opalescent zone will appear at the plane of contact of the fluids. If the proportion is small several minutes may elapse before its appearance. A quantitative estimate of the amount of albumen, sufficient for clinical purposes, may be obtained by noting the amount of precipitate to the liquid employed; but a more accurate estimate may be formed by the use of Roberts' dilution method, described in the 'Lancet,' vol. i, 1876, p. 313.

Fig. 331.



Urinary casts.

Picric acid test.

Picric Acid Test.—This test, as recommended by Dr. G. Johnson, is used as follows:—Fill a test-tube six inches long with four inches of urine, and upon this pour an inch of the picric acid solution (six or seven grains to the ounce), so as to mix only with the upper layer of the urine.

If albumen is present a cloud or coagulum of albumen will appear as far as the yellow colour of the test solution extends.

If the tube be allowed to stand the precipitated albumen will gravitate, and form a film or deposit at the junction of the coloured and unstained portion of the urine. The turbid portion of the liquid must then be boiled, and if the precipitate is permanent it must be albumen.

Dr. Pavy's test.

Dr. Pavy's Ferrocyanide of Potassium Test, in which the Spirit Lamp is not required.—Add to the suspected urine a small quantity of a solution of citric acid. If this causes a precipitate of urates add a little hot water, which will redissolve it; then add some solution of ferrocyanide of potassium, and if albumen is present it will be precipitated, and nothing else, as far as is known, will.

It must be added that in all methods of testing, any initial turbidity of urine from the presence of urates must be got rid of by heat. It should also be ascertained that the patient is not taking cubebs or copaiba, for all the oleo-resins are thrown down by acids. Prior boiling of the liquid will also obviate fallacy from this cause.

Test papers.

For bedside purposes Pavy's pellets and Oliver's test papers are trustworthy.

At times the *débris* of *kidney structure* or *cancer* products may be found.

Spermatozoa.

Spermatozoa (Fig. 330A), sarcinæ, or hydatids, may likewise be present. All these materials can be made out only by the microscope.

Blood in urine.

Urine containing *blood* is either *red* or *smoky;* that containing *bile*, dark or olive brown. *Black* urine is commonly the result of the poisonous absorption of carbolic acid.

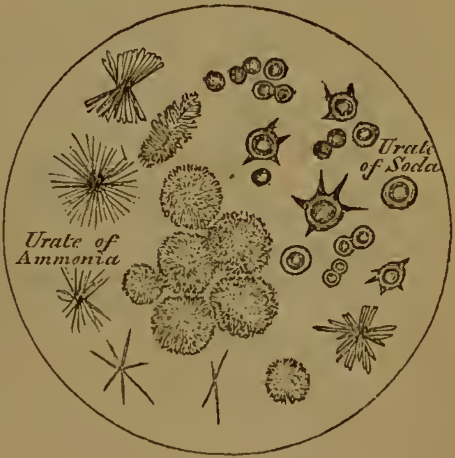
Pus in urine.

Pus, when poured into the urinary passage, has usually little mucus with it; that secreted by the bladder is greatly mixed with it. Purulent urine is always albuminous.

Urates.

The *urates* generally appear as "brick-dust or "red gravel" deposits. When they do so, as soon as the urine has cooled down, there is generally some diminution in the watery constituents of the urine with febrile disturbance. When they are deposited some hours after micturition increased acidity of the urine is indicated from changes in the pigment or extractives, the acids being probably the lactic, acetic, and butyric. A drop of acid added to such urine will cause the settlement of the deposit (Fig. 332). Urates are dissolved by heat and alkalies.

FIG. 332.



Urates.

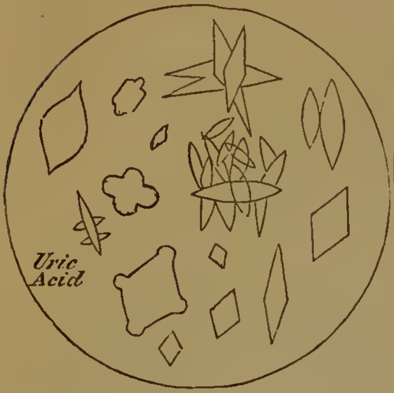
Uric acid.

Uric acid appears in transparent urine of a yellow colour, and is usually deposited slowly. The crystals are variously formed, and chiefly rhombic with the angles rounded off or lozenge-shaped. (Fig. 333.) They are soluble in potash or soda, but insoluble in mineral acids.

Oxalate of lime.

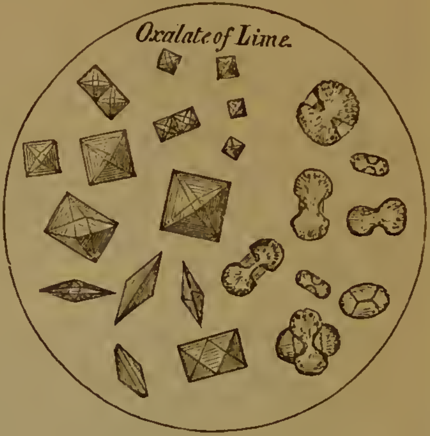
Oxalate of lime is probably secreted under the same circumstance as the uric acid, and has the same pathological signification. Dr. Parkes held this view, and believed that it may be a substitution for the excretion of the carbolic acid of the lungs. It appears as octohedral crystals or dumb-bell like bodies (Fig. 333A), which are insoluble in acetic acid and alkalies, though soluble in the mineral acids, such as the nitric, without effervescence.

FIG. 333.



Uric acid.

FIG. 333A.



Oxalate of lime.

Phosphates.

The phosphates appear as the ammoniaco-magnesian phosphate, the phosphate of magnesia, and the phosphate of lime.

FIG. 334.

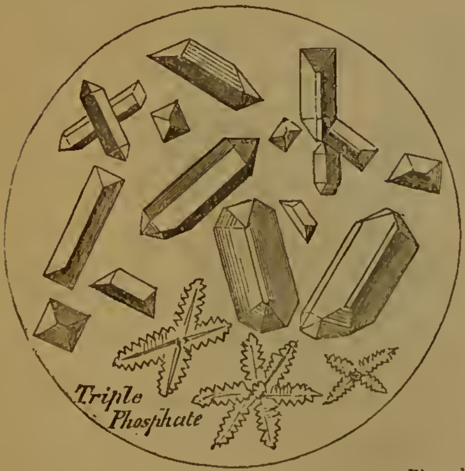
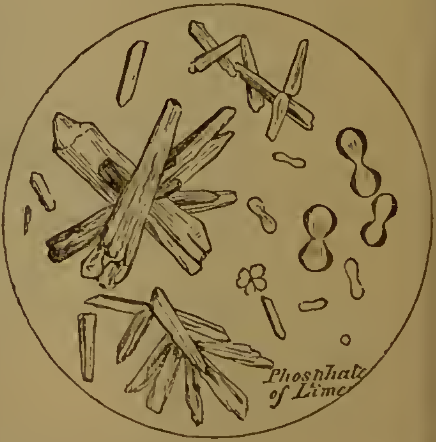


FIG. 334A.



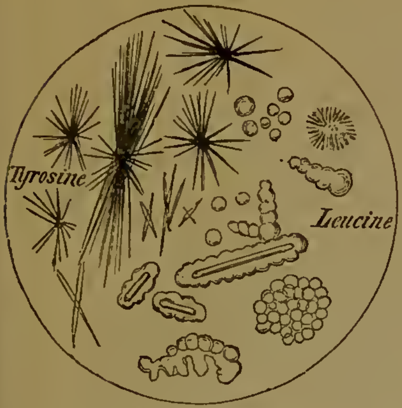
Phosphates.

The first occurs in the form of beautiful, colourless, transparent prisms, or in foliaceous or stellar prisms. It is supposed to be deposited as a consequence of the decomposition of urea, and is first seen upon the surface of the urine as an iridescent pellicle (Fig. 334).

It is soluble in acetic acid, but not by heat.

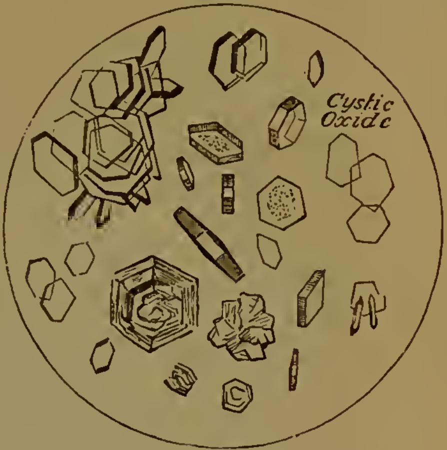
The phosphates of magnesia and lime occur as white gravel, usually amorphous, at times crystalline. They are mostly found in alkaline urine mixed with pus or mucus (Fig. 334A). They are insoluble by heat, but soluble in acetic or the mineral acids.

FIG. 335.



Tyrosine and Leucine.

FIG. 335A.



Cystine.

Tyrosine.

Tyrosine appears in the form of fine needles or stars of a greenish yellow colour (Fig. 335). When treated with nitric acid, urine containing it becomes of a deep orange colour, and, on evaporation, of deep yellow. A solution of soda dropped upon this flake produces a red tinge.

Cystine occurs in colourless hexagonal plates (Fig. 335A), or light fawn-coloured amorphous deposit, and is soluble in ammonia and hydrochloric acid, insoluble in acetic acid.

Heat dissolves only the urates of the urine.

Potash dissolves all deposits except the phosphates and oxalate of lime.

Hydrochloric acid dissolves all except uric acid.

Characters of healthy urine.

"Perfectly healthy urine should show no appreciable deposit; when, however, it becomes concentrated from deficiency of the watery excretion, then the uric acid is thrown down in the form of an urate. This may occasionally occur within the body, but far more frequently after the urine has been voided; sometimes, however, this change ensues so rapidly that the urine is erroneously supposed to have been passed in that condition. The presence of a solid body in any part of the urinary tract favours deposition very much, and hence urine which would otherwise remain clear, may yield a deposit to any substance previously present in the same tract, and may thus add considerably to an already existing calculus. The appearance of the numerous layers so frequently seen around a central nucleus, both in renal and vesical calculi, is thus easily explained. When, however, the urine becomes further altered in composition—if, for example, a free acid is either excreted with the urine, or rapidly generated in it through the setting up of the lactic fermentation,—the uric acid becomes liberated from its state of combination, and in a form more or less altered by the presence of colloid matters, is deposited on a previously existing calculus, or is passed as

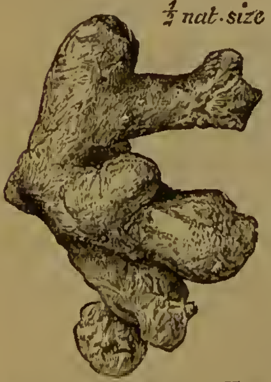
Gravel.

separate rhomboidal crystals or in aggregated masses, constituting gravel or sand. I should feel disposed to confine the name of 'sand' or 'gravel' exclusively to such deposits, which, I believe, seldom form the nucleus or become the starting-point of any calculus. I may add, that urine possessing these characters is frequently voided for months and years, without the occurrence of any appreciable inconvenience to the patient. It is true that a calculus may be augmented by contact with such an urine; but, as I have said, it seldom originates in this way. Gravel or sand consists of uric acid previously in a state of solution, which has become precipitated by the occurrence of some change in the urinary excretion." "It would, however, appear probable that the initial step in the formation of a calculus is the exudation of some colloid-mucus, or some other albuminoid substance into the urinary passages. Into this colloid, urates or oxalate of lime or both are precipitated, and combining with it, form molecular aggregations of a globular character, which constitute the foundation of the subsequent growth." Garrod 'Lumleian Lectures,' 1883.

Formation of stone.

When any of the inorganic deposits just described mass together either by themselves upon any nucleus of organic matter such as blood or a foreign body, a stone is the result. This stone may form in the kidney and remain there; it may pass into the bladder and be emitted with the urine, or rest there and increase; or, the calculus may have its origin in the bladder either from the precipitation of the earthy constituents of the urine, or, from the irritation of a foreign body introduced from without. A stone having a renal origin and resting in the bladder seems to have the power of extracting from the urine its inorganic elements, and thus rapidly increasing; oxalate of lime, urate of ammonia, uric acid, phosphate of lime or triple phosphate, being precipitated by its presence, and aggregating or crystallising upon its surface. It acts, too, after a time, as a foreign body, sets up bladder irritation, and, as a consequence, the phosphatic salts are deposited from the decomposition of the urine. Dr. Owen Rees has shown in his 'Croonian Lectures,' 1856, that where irritation of the bladder exists either from a calculus, foreign body, or other cause, the mucous membrane secretes an alkaline fluid that tends to cause a precipitation of the earthy phosphates, and the formation of a phosphatic deposit upon a calculus.

FIG. 336.



Renal calculus. Guy's Hosp. Mus., Prep. 2077^{36}.

On renal calculi.

Characters.

Renal calculi are generally composed of uric acid, urate of ammonia, or oxalate of lime, and Beale states, that microscopic renal calculi of phosphate of lime are by no means uncommon. These concretions may be either impacted in the uriniferous ducts, lodged in pouches connected with the ducts and increase in the structure of the kidney, or pass into the pelvis of the kidney. They may be single or multiple and the size of a hemp-seed, nut, or walnut, or, they may be so moulded to the divisions of the pelvis of the organ as to assume an arborescent shape such as that figured (Fig. 336). Dr. Gee has lately recorded a case in which a renal calculus weighed 36¼ ounces ('Med.-Chir. Trans.,' 1874). There is reason also to believe, that a renal, like a vesical calculus, may form upon a nucleus of blood the result of an injury.

Symptoms.

When the stone is fixed in the structure of the kidney, its presence may be indicated by but few, if any, local symptoms. When it moves about in the pelvis of the kidney, it gives rise to symptoms known as those of *nephritic colic;* paroxysmal lumbar pain, with nausea, vomiting, or collapse, irritability of bladder, and at times painful micturition and hæmaturia being the chief symptoms.

When the stone passes into the ureter all these are aggravated, pain shooting down the groin, thigh, and scrotum of the affected side, with retraction of the testis, and these continue till the stone reaches the bladder, when a sudden relief is felt.

Effects produced.

When calculi accumulate in the kidney and increase in size, inflammation, suppuration, and even the entire destruction of the kidney, may ensue; although it is remarkable to what an extent one kidney may be destroyed without giving rise to any symptoms. On the other hand, severe symptoms may appear for a time and subside, either to re-appear months or years later, or not at all. In exceptional cases a renal calculus may be discharged externally through the loin with suppuration; Dr. Cayley showed such a specimen at the Pathological Society, 1874. A stone may be impacted in the ureter, and not rarely at its vesical orifice, when it will give rise to renal symptoms by obstruction, &c.

After a stone has reached the bladder, it may be discharged with the urine or become fixed in the urethra and cause obstruction; or, it may rest in the bladder and increase, and require surgical treatment.

Vesical calculi.

It is probable that most vesical calculi have a renal origin, and that some small nucleus of either uric acid or oxalate of lime forms in the kidney and passes downwards into the bladder, where the urine supersaturated with these constituents deposits them upon the renal calculus, and increases its size. Stones thus formed have been called *primary calculous formations.*

Foreign bodies as nuclei.

When a foreign body has been introduced into the bladder, or a stone has descended into it and sets up much bladder irritation or cystitis, the phosphatic salts of the urine are deposited upon its surface, and stones thus formed are, therefore, phosphatic. When urine is retained in the bladder and decomposes, either as a consequence of cystitis following paralysis, diseased prostate, urethra, or a new growth, its earthy constituents are thrown down and phosphatic calculi or concretions are formed, such deposits being known as *secondary calculous formations.* How far these latter may increase so as to form stones is yet an open question.

How concretion results.

All these chemical constituents, however, require to be held together by a kind of cement: "Marcet referred it to the mucous secretion of the bladder; Fourcroy and Vauquelin to albumen, and sometimes to gelatine with an admixture of urea; Berzelius, however, could not determine whether it was composed of fibrin, albumen, gaseous matter, or mucus; Brande considered it to consist of a mixture of gelatine with urea; Scharling holds that the smaller calculi are always enveloped by a layer of mucus, albumen, or some other organic matter, the flocculi of which entangle and ultimately determine the crystallisation of the more insoluble ingredients of the urine; and Dr. Hoskins, as quoted by Gross, extends this view to the minutest particle of the concretion."—*Coulson.*

Urinary calculi of two classes: urates, phosphates.

Urinary calculi, says Poland, may be arranged like the deposits into two distinct classes. The *first* will include calculi of *uric acid* and the urates, with their modifications the oxalates, *xanthic* and cystic oxide (Dr. G. O. Rees regarding the oxalate of lime as uric acid or urates, altered after secretion); the *second*, the phosphatic calculi. A *third* class may be added, consisting of the rare calculi of carbonate of lime, the fibrinous, the uro-stealith, and the siliceous formations, other chemical ingredients being present, such as organic matters, carbonate of magnesia, silica, oxide of iron, benzoate of ammonia, oxalate of ammonia, phosphate of iron, urea, &c. The oxalates are the heaviest stones, the phosphates the lightest and largest; few exceed an ounce in weight. Coulson records one, however, over six pounds. Recent calculi contain moisture, and consequently are heavier than old. Stones vary in shape according to their position. Thus, *renal* calculi are generally irregular, often arborescent; those in the *ureter* elongated, approaching a cylindrical form. *Bladder* calculi, when single, are more ovoid and flattened; when multiple, faceted. The mulberry stone or oxalate is always tuberculated, mostly globular, and hard; the uric acid and urate calculi smooth and regular; the phosphatic irregular, of odd shapes and soft. The dumb-bell calculus is usually prostato-vesical or encysted.

Additional classes. Calculi in general. Weight. Size. Shape.

Colour.

The colour of the layers of a calculus is due to the fact that the uric acid or urates in their deposition take with them the colouring matter of the solution from which they are deposited. All calculi, when associated with bladder irritation and ammoniacal urine, become covered with a white coating of phosphatic deposit. A stone of uric acid is usually fawn or brown coloured, of urate of ammonia cinder-grey, of oxalate of lime brown or blackish-green, of xanthic or uric oxide cinnamon-brown, of cystic oxide a grey-greenish hue.

Smell.

Phosphatic calculi, as are other forms when covered with a like deposit, are often horribly fœtid and ammoniacal. They are too commonly soft and friable.

Appearance of section of calculus.

The *section* of a calculus reveals its structure, and, while some are homogeneous, the majority display concentric layers of different degrees of thickness; exceptional examples displaying fine lines radiating from its centre of a crystalline form, which may be seen in the cystine calculus (Fig. 340).

Alternating calculi.

The different layers of a calculus may have the same composition, or differ widely. When the latter, the calculus is known as *alternating*; but any single layer is generally composed of several ingredients. "It is probable," says Odling, "that if a very exact analysis were made, each of the layers of nearly every calculus would be found to contain uric acid, alkaline urates, phosphate of lime, and ammonio-phosphate of magnesia, with or without the other constituents of calculi. Moreover, most calculi contain traces of all the salts naturally existing in the urine, as well as colouring matter, mucus, &c."

Most calculi are divisible into a central portion or *nucleus*, with an outer portion or *body*, and occasionally there is an outside *crust* of phosphate (Fig. 339).

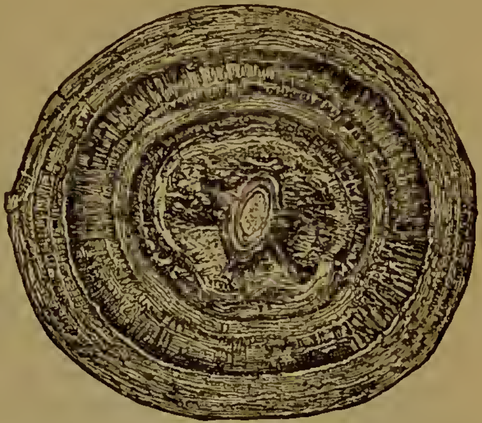
The nucleus may be of the same nature or different from the body.

It may be composed of some organic material, such as blood, mucus, &c., or a foreign body introduced from without (Fig. 341).

On uric acid calculus.

1. *Uric acid* calculus is by far the most frequent, forming, according to Cadge, nine tenths of all primary formations ('Address on Surgery,' 1874). It is usually derived from the kidney, and when retained in the bladder becomes a flattened oval stone of a fawn or yellow colour, with a compact and occasionally crystalline laminated structure (Fig. 337). The uric acid is generally mixed with the alkaline urates in variable proportions.

FIG. 337.



Uric acid calculus, with nucleus of oxalate of lime. Prep. 2193.

This form of stone is often found in gouty subjects, and generally in the middle period of life. It is usually associated with acid urine, and such as is prone to deposit the urates. The nuclei of most calculi are of this nature. In the catalogue of calculi of the Royal College of Surgeons of England, plate iv, fig. 6, there is a drawing in which a uric acid calculus is shown to have formed round a piece of steel.

Urate of ammonia calculus.

2. The *urate of ammonia* calculus is not common. In Guy's Museum there are only seven specimens of it out of 394 calculi. Most compound calculi contain this substance in abundance. They are seldom large, mostly smooth, and of a grey-fawn colour. On section they are homogeneous or indistinctly laminated, and have an earthy fracture. They are more commonly found in children, although they have been removed from adults. Guy's Museum contains a bottle (No. 2213) in which are 142 calculi of this nature which Sir A. Cooper removed from the bladder of one patient. They are of the colour of pipe-clay, and in the form of cubes with the edges and angles rounded off.

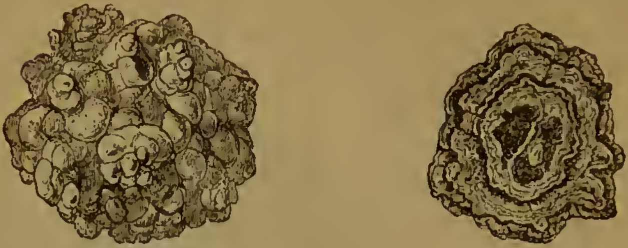
The rarity of this form of calculus is probably due to the solubility of the salts.

Oxalate of lime calculus.

3. The *oxalate of lime*, or mulberry calculus, stands second in point of frequency to the uric acid in European countries; though Dr. H. V. Carter tells us that the oxalate of lime ingredient predominates in all urinary calculi in northern India ('St. George's Hospital Reports,' 1871-2). These calculi vary in colour from grey to a rich brown or black, and have an external form of a tubercular, angular, or spinous character, being rarely perfectly smooth (Fig. 338). In some, the surface is studded with spines, so acute and slender as to resemble thorns, while in others there is a coating of acute octohedrons of transparent

oxalate of lime, giving an extremely beautiful appearance. Occasionally these crystals are opaque, and the octohedron is flattened, when the calculus appears as if studded with pearl-spar (Prep. 2139^5, Guy's Museum). The intervals between the spines are sometimes filled with urates or phosphates, which give the stone an ovoid form.

Fig. 338.



Mulberry calculus. Its section.

Section of.

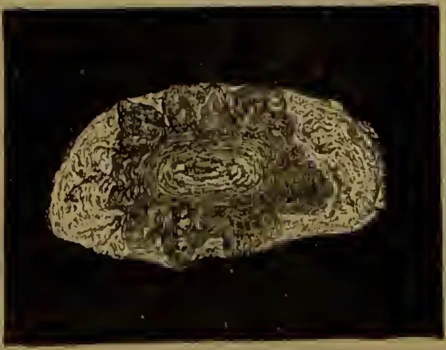
The section of a mulberry calculus is generally that of an imperfectly lamellated structure, the consecutive layers forming waving lines, which often resemble the knotted heart of an oak (Fig. 338); but occasionally a layer of oxalate of lime is to be seen arranged around the interior one with great regularity, having a remarkably radiated appearance, like a series of infinitely minute needles placed side by side, and presenting a perfectly porcellaneous structure. In compound calculi the oxalate of lime deposit gives to the character of a stone a remarkably beautiful appearance resembling that of fortification agate.

The oxalate of lime calculi that have their origin in the kidney (and pass soon after their descent) are usually small, smooth, hemp-seed bodies.

White oxalate of lime calculus.

The crystalline mulberry stone is of a pale-brown colour, and, according to Dr. Yelloly, composed of nearly pure oxalate of lime. Poland had a case of this kind, in which the stone on extraction crumbled to pieces from the absence of any binding material of animal matter. He gives also, on the authority of Mr. C. Williams, of Norwich, an account of a pure white oxalate of lime calculus. "This," he says, "is of a milk-white colour, possesses a highly-polished surface, is of extreme rarity, and is generally, if not always, found in the kidney; its external surface presents no crystals, but is perfectly smooth, though it may be spinous. In the museum of the Norwich Hospital are three specimens."

Fig. 339.



Mixed calculus.

Its nucleus.

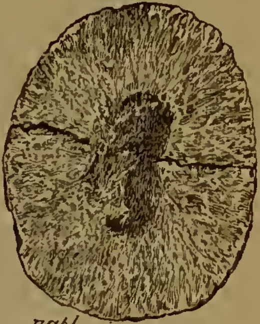
The nucleus of a mulberry stone usually contains uric acid (Fig. 339), while the body is often made up of alternate layers of uric acid and oxalate of lime. The urine is generally acid. Singular as it may appear, these rough mulberry stones rarely give rise to so much bladder irritation as the smoother forms; possibly they roll about less.

Cystic oxide calculus.

4. *Cystine* or *cystic oxide* calculus is of rare occurrence, and is a formation of the kidney. Wollaston discovered it in 1810, and the second calculus which he analysed is in Guy's Museum, and is about an inch in diameter (Fig. 340), and contains sulphur in large proportions. Poland points out its hereditary nature, since out of 22 collected cases, 10 occurred in four families, and in these the subjects of the complaint were brothers. The calculi are generally rounded or smooth, but may be slightly tuberculated. They have a wax-like lustre, and appear semi-transparent and glistening. When recent, they are of a pale yellowish-brown colour, but when kept long assume a pea-green appearance. Dr. Bird remarks upon this point, "It has been suggested to me by Dr. Prout and Dr. Willis that this alteration in tint may in some way depend upon changes produced in the sulphur."

They are soft in consistence, and on section, present a very imperfectly radiated structure, with no tendency to a development of concentric layers. They yield easily to the knife when scraped, and form a perfectly white powder, whether the calculus be green or brown. The fracture is crystalline.

FIG. 340.



Cystic oxide calculus. Guy's Mus., No. 2143.

Phosphate of lime calculus.

5. *Phosphate of lime calculus.*—There are two varieties of this form; *the one*, as described by Wollaston, of *renal* origin, consisting of neutral phosphate of lime. These usually have a smooth polished surface of a pale brown colour, and are regularly laminated, the laminæ being so slightly adherent as to be easily separable into concentric crusts; in some, lines are seen radiating in a direction perpendicular to the laminæ. These calculi contain a considerable proportion of animal matter.

The other form is of *vesical* origin, and composed of phosphate of lime similar to that of bones, and hence often called "bone earth" calculi. They are more common than the former, and constitute irregular masses resembling mortar, or a granular, semi-crystalline powder, enveloped in a tenacious mucus; these latter being more concretions than stones. There are three cases on record in which the phosphatic calculus has been followed by other forms. Foreign bodies, as a rule (and vesical calculi of long standing are such) have the earthy phosphates deposited upon them.

Triple phosphate calculus.

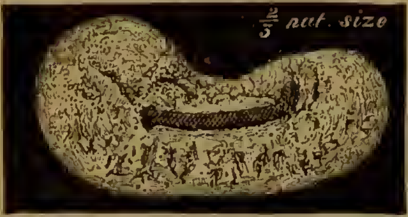
6. *Triple phosphate*, or ammoniaco-magnesian phosphate *calculus* is rare. The College of Surgeons possesses but three specimens, and Guy's only two. No. 2154 in Guy's Museum shows one which has no nucleus, but a central cavity lined with delicate crystals of triple phosphate, resembling the crystals of quartz in the cavities of flints, while No. 2152 is a section of a large calculus of the kind on a nucleus of a tobacco pipe. Fig. 341 represents such a calculus formed round a piece

of broken catheter, and occurred in the practice of my friend Dr. Kitchener.

Fusible calculus.

7. The *fusible* calculus, or the phosphate of lime with phosphate of magnesia, and ammonia calculus, is the *most frequent* of the phosphatic calculi. It is generally due to the presence of ammoniacal urine from cystitis, and constitutes the crust that forms on other calculi, or on foreign bodies introduced into the bladder. These calculi increase to a large size, are irregular, and mould themselves to the position in which they are placed, often filling the bladder. Their colour is white, grey, or dull yellow, their consistence friable and more earthy than any other variety, sometimes so soft as to resemble moist chalk.

Fig. 341.



Triple phosphate calculus with nucleus of a piece of catheter.

Their appearance on section is thus described by Mr. Taylor in the catalogue of the calculi of the Royal College of Surgeons of England:—"They are frequently composed of concentric laminæ, which in general adhere but slightly to each other; between the laminæ shining crystals of the triple phosphate are often observed; or some of the laminæ are entirely wanting, and these form a white friable mass like chalk; in others, they appear semi-crystalline, as if made up of numerous small crystals confusedly aggregated together. In calculi that have a crystalline and glistening texture the triple phosphate is most abundant, while the calcareous phosphate is in excess in those which have an amorphous earthy appearance."

Carbonate of lime calculus.

8. The *carbonate of lime* calculus is a very rare form. Thudichum says that prostatic calculi sometimes consist almost entirely of this substance. In Guy's Museum, No. 2187^{50}, such a vesical stone exists of a snow-white colour, with a nucleus of uric acid. Odling says that calculi which have undergone partial decomposition in the bladder often contain this ingredient.

Xanthic oxide calculus.

9. The *uric* (of Liebig) or *xanthic oxide* calculus which bears a close relation to uric acid, is as rare as the last. Dr. Marcet detected the substance in a stone of eight grains' weight, but no remains of it are at Guy's. Stromeyer re-discovered it in a stone weighing 335 grains, removed by Langenbeck, which was laminated, and of a bright brown colour. A portion of this calculus is in Guy's Museum, No. 2145^{90}.

Fibrinous calculus.

10. The *fibrinous calculus* of Marcet and Prout requires notice, although, according to Bird, it must be regarded as a portion of dried inspissated albuminous matter exuded from an irritated kidney. Such pseudo-calculi present considerable lustre and a vitreous fracture.

Uro-stealith calculus.

11. The *uro-stealith calculus* seems to be made up of fatty matter. It has been described in Heller's 'Archives,' 1844-5, and by Moore in the 'Dublin Quart. Journ.' for 1854. In Hunter's collection there is likewise a fine specimen of the kind.

Blood calculi.

12. *Blood calculi* have likewise been described by Marcet, and

Roberts has recorded one taken from a sheep by Mr. Lund of Manchester. All recorded cases have been connected with renal hæmaturia. Silica, and also the urates of soda and lime, are occasional ingredients in a stone.

Diagnosis of stone from character of urine.

With this brief description of the varieties of stones, for much of which I am indebted to Poland's article in 'Holmes's System,' it may be well to consider if any diagnosis of their nature can be made before their removal, and for this purpose the character of the urine is of great value.

If it be *acid* the stone is either uric acid, oxalate of lime, or a mixture of the two; and as the uric is more common than the oxalate, the probabilities point to the former. When the urine contains either ingredient, the nature of the layer that is being deposited is established.

Gouty people are more prone to uric acid than to oxalate calculi.

If the *urine be alkaline* from *fixed* alkali as indicated by the permanent change in the test paper, the earthy phosphates or the carbonate of lime calculi are indicated; if from the *carbonate of ammonia* the result of decomposition of the urine, the mixed phosphates; that is, a crust of these is being deposited upon an unknown nucleus.

When a small stone has been previously passed and examined, great help is given towards the formation of an opinion, and also when gravel has been passed.

On frequency of stone.

In England, one person in 100,000 dies annually from stone, in Scotland one in 50,000, and in Ireland one in 200,000. The proportion of deaths varies greatly in different districts, Cadge informing us in his very able address given before the British Med. Assoc. for 1874, that in Norfolk, the mortality from stone is one in about 42,000, and in Cheshire, one in about 425,000.

In the sexes.

The bills of mortality indicate, that ten males die to one female from calculous disease, and stone is said to be found in men twenty times more frequently than in women. It is probable, however, that stones form as readily in the one as in the other, but that in women, owing to the shortness of the urethra and its capability of dilatation, they are more readily discharged, large stones not being rarely discharged in the female sex by natural efforts. (*Vide* Stone in Female.)

Age at which calculus met with.

The statistics of M. Civiale, Coulson, and Thompson indicate that about 60 per cent. of the cases of calculi are found in subjects under twenty years of age, 10 or 12 per cent. in those between twenty and forty, 12 to 15 per cent. in those between forty and sixty, and about 10 to 12 per cent. above sixty. But in taking these absolute numbers and comparing them with the relative numbers of persons living at the different periods of life named, it would appear that children and young persons are less liable to calculous disorders than has been commonly supposed, and that for twenty years and upwards, the tendency goes on increasing in a very remarkable manner to the end of life; or, as Sir H. Thompson puts it, that the "proportion of elderly calculous patients to the existing population at their own ages is larger than the proportion of children afflicted is to the number of existing children."

Two thirds of the cases of stone that have come under our notice in hospital practice are in children, and half of these are under five years of age. These young ones are, moreover, generally of a healthy and ruddy aspect, and form a contrast to those admitted for other diseases, the formation and presence of a stone in young life being apparently not incompatible with good health.

Causes of stone.

With respect to the causes of stone I concur with Cadge, that "it is safer to attribute lithuria to dyspepsia and mal-assimilation, which probably concerns all the digestive organs, than to fix the fault mainly on one," and that this condition arises from the want of milk as an ordinary article of diet, for whilst in the children of the poor, stone in the bladder is so common as to constitute half the whole number of cases met with in practice, it is seldom seen in the more opulent classes.

STONE IN THE BLADDER.

On calculus vesicæ.

When a stone has descended from the kidney into the bladder it may give rise to no more marked symptom than a slight urinary irritation; and when it passes with the urinary stream this symptom will disappear.

Symptoms.

When the calculus rests in the bladder and increases, it usually gives rise to more characteristic symptoms, which differ widely in different subjects, and apparently have little to do with the nature of the stone.

Slight.

May be overlooked.

Hæmaturia.

Pain after micturition.

Interrupted flow of urine.

Frequent desire to pass water.

In some, indeed, in the majority of cases, the symptoms are so slight as to be disregarded, whilst in the larger number the symptoms have frequently existed for many months, if not for years, before advice is sought. Indifference or carelessness may occasionally be the cause of this delay, but as a rule it is due to the uncertainty of the symptoms and the comparatively little inconvenience the patient suffers. It is a rare thing, however, for a parent to seek professional advice for a child suffering with stone until *hæmaturia* has been observed, some prolapse of the rectum taken place, or the *pain* which the child experiences after micturition become pronounced; although in such a case it will generally, upon inquiry, be learnt that the child for many months had been observed to play with or drag the penis after micturition, that the steam of urine had occasionally been interrupted in its flow, and that a frequent call to make water had long existed.

These symptoms, therefore, with tolerable accuracy denote the presence of a calculus, though its existence can only be affirmed positively on its absolute detection by a sound. Yet nearly all the symptoms which have been enumerated can be produced by other and less important conditions, and more particularly by an elongated and adherent prepuce.

Retention of urine.

Incontinence of urine.

Retention of urine in an otherwise healthy child is almost always caused by the impaction of a stone, and, when incontinence exists, it frequently indicates the presence of a calculus which has been forming for a lengthened period, and which is often connected with renal as well as vesical changes of an organic character.

In adult life, indifference to early symptoms is not common, and a frequent desire to pass water when persistent will soon induce a man to seek advice; and as this may be the only symptom of stone, it should neither be disregarded nor lightly treated. Indeed, with such a symptom, a sound should at once be passed, this being the readiest and best means of proving whether a stone be the cause or not. The symptoms that indicate the presence of a calculus will be found to vary, from the slightest irritation of the bladder to the severest agony, and those which have been described will be present in different degrees of severity or in different combinations. The importance, however, of an early detection of a calculus is so great, that in every case of persistently irritable bladder which is not clearly the product of some other affection, it is better to suspect the existence of a stone and examine with a sound than run the slightest risk of overlooking it, and consequently of increasing the dangers (which are always great) of exciting or keeping up organic disease in the bladder and kidney. It is to be remembered that the presence of a calculus is chiefly dangerous to life from the organic renal changes it is liable to excite; and that neither the operation of lithotrity nor lithotomy is commonly fatal if such changes have not taken place. The early detection of a stone becomes, therefore, necessarily a point of the highest importance.

Early detection of stone important.

Examination with a sound.

The confirmed symptoms of vesical calculus in the adult are, pain of different degrees of intensity referred to the bladder and aggravated on any sudden movement, such as by riding, jumping, or jolting of the body. Pain during and particularly after the act of micturition, extending along the urethra to the penis; exhausting straining, and the passage of blood. During the flow of urine a sudden arrest of the stream will often be observed, this arrest being followed after the lapse of a moment of time by the return of the flow, and this interruption may be repeated more than once in each act of micturition. Retention or incontinence of urine may complicate the case. Rectal irritation and tenesmus, with or without prolapse, are also frequent symptoms; and reflected pains along certain nerves are very constant. Thus, pain in the glans penis is most common, and pain in the scrotum, perinæum, and down the thighs is pretty constant. John Hunter relates a case of stone in which pain in the left forearm was the only indication of a want to make water. Sometimes the bladder symptoms may be severe for a time and then cease, or suddenly appear after any extra exertion. In the former case the stone probably becomes fixed in a sacculus, and ceases to irritate; in the latter it escapes from a sacculus and makes its presence known. As long as the bladder remains healthy the changes in the urine will be but slight, but when the stone acting as a foreign body sets up cystitis, all the symptoms of that affection will appear, with the muco-purulent discharge and ammoniacal urine.

Confirmed symptoms of stone in adult.

Subjective symptoms.

Condition of urine.

When the symptoms have existed for any lengthened period the probabilities of renal complications are great, as indicated by albuminous urine with lumbar pain and anasarca.

In rare cases a persistent erection of the penis is present.

But these symptoms of stone are merely *subjective;* they are those given by the patient; and however suggestive of the affection they may be, are not conclusive, since all may be produced by other bladder affections. The only conclusive evidence to be obtained is by the physical examination of the bladder, by the "sounding" of the patient with a metallic sound or catheter, by the "ringing" of the stone against its end.

On sounding.

To sound a patient suspected of stone the horizontal position should be selected, and the pelvis raised on a pillow. The bladder should contain a few ounces of urine if possible, three or four being enough

Position of patient.

and eight being ample, and the rectum should be empty. When the bladder is empty, some few ounces of water should be injected. For a child, a small metallic bulbous catheter or sound with a short sharp curve should be used (Fig. 343), the bulbous end being one size larger than the stem, and for the adult a similar instrument suffices (Fig. 342).

Instrument selected.

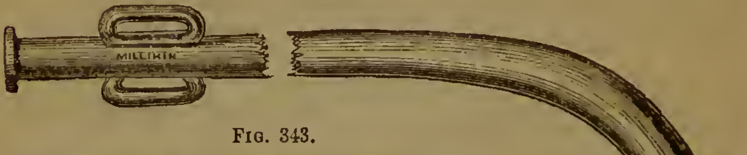
Catheters, best.

An instrument with a long curve may glide over the stone, and will certainly fail to find one lodged behind the prostate; it is also less moveable. The short-curved catheter can be made to turn downwards to explore the base of the bladder with the same facility as it can the sides. A hollow sound or catheter is better than a solid, as a stone will often be detected on drawing off the urine, as the bladder in the act of contracting may throw the stone upon the end of the instrument, and thus make its presence known. The catheter should not have a stylet.

Mode of sounding.

The instrument should be warmed, freely oiled, and passed carefully and slowly into the bladder, nor ought its introduction to give pain. It should be at first pushed well home towards the posterior part of the organ to search its base, and then turned first to one side and then to the other to search its sides, the sound during the operation being gradually withdrawn and again pushed back. When an enlarged prostate exists, and a stone is expected to lie in a pouch behind the so-called gland, the beak of the instrument must be turned backwards, and in this way every corner of the bladder can be examined. When no "ring" of the calculus is first obtained, the water may be partially drawn off, and by this manœuvre it may be heard. In children the introduction of a finger into the rectum facilitates at times the search, and the pressure of the hand above the pubes, often facilitates the detection of the stone.

Fig. 342.



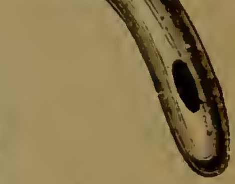


Fig. 343.

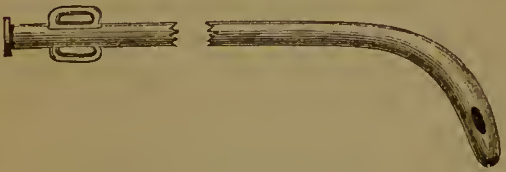


Fig. 342.—Cath. No. 10.

Fig. 343.—Child's natural size.

When enlarged prostate exists.

Anal examination.

A large stone is generally touched on the sound entering the neck of the bladder, and a small one usually lies at the base of the bladder, either to the right or left of the median line. An encysted stone is a rarity. A stone may often be felt at one time and not at another; consequently, when well-marked symptoms exist, any hasty opinion as to its absence is to be avoided. Mr. F. L'Estrange, of Dublin, has invented a sounding-board to be fastened to the top of the sound for

May escape detection.

intensifying the noise produced by the instrument when it strikes a stone in the bladder. It is an ingenious instrument.

The late Mr. Napier invented a pewter sound the surface of which being oxidised by nitric acid is easily scratched when coming in contact with a stone. It seems to be of use when the stone is otherwise difficult of detection. For the same purpose the microphone may possibly prove of value.

Ascertain size, nature, and number of stones.

The operation of sounding ought to reveal something more, however, than the presence of the stone, such as its size and nature, and whether more than one is present. The size is indicated by the extent of surface passed over by the point of the instrument; and the nature, by the noise emitted on the striking of the stone, such hard stones as the uric acid or oxalate of lime giving a sharp, clear, ringing sound; while the light and soft phosphatic calculi yield a dull one. The roughness of the oxalate of lime calculus may also be generally felt. In children, with the finger in the rectum, the size of the calculus can often be readily made out. The character of the urine, as already pointed out, throws some light upon that of the calculus. The value of chloroform in facilitating the search for a stone, more particularly in children, is so great, that it should almost always be employed. In sounding, the Surgeon must not be misled by the sensation given by the rugous or roughened bladder, the viscus feeling hard and uneven to the end of the sound, and the examination giving pain. When this condition is made out all sounding should be given up, for the existence of such with a stone is almost unknown.

Use of chloroform.

Fallacies in sounding.

In children, the instrument may strike against the sacrum or spine of the ischium and mislead, but in this case there is no sound emitted; indeed, the Surgeon must be careful to *hear* as well as to *feel* the stone before he is satisfied as to its presence, as there are many affections of the bladder and prostate that in their clinical history and physical symptoms simulate those of stone, but in none is any perceptible sound given when using the metallic instrument, as in stone. The only unequivocal sign of calculus is the sound produced on striking the stone.

Must hear and feel the stone.

In forming a diagnosis, the Surgeon should always remember that when irritation at the neck of the bladder arises from stone, it is referred to the glans penis; when from disease of the bladder, to the organ itself; and when from disease of the prostate, to the perinæum or rectum.

Vaginal examination in female.

When a calculus is suspected in the female, a vaginal examination will often enable the Surgeon to feel the foreign body. It will also remove all such sources of fallacy as are prone to follow from uterine affections. In female children, a rectal examination will do as well.

Treatment of stone in bladder.

TREATMENT.—A calculus having been detected in the bladder, there is only one form of treatment which can be successful, and that is its removal; for, with rare exceptions, a stone, if allowed to remain, will set up, not only bladder disease, but kidney mischief, ending in death.

A stone may be removed by a cutting operation, *lithotomy;* or by a crushing one, *lithotrity;* the treatment by *lithontriptics* and *electrolysis* has hitherto met with indifferent success.

In former times, small stones were removed from the bladder by forceps. Sir B. Brodie, Sir W. Blizard, Boyer, George Bell, and others, have recorded many such cases. Sir A. Cooper's celebrated case, in which he removed eighty small stones by this means, is well known; but the practice has been entirely superseded by the lithotrite.

On lithontriptics.

Lithontriptics, or stone solvents, were used long before the composition of urinary calculi had been made known, and were mostly alkaline remedies; and the most celebrated nostrum of Joanna Stephens, for which the Government of 1739 gave a reward of £5,000, was composed of burnt eggshells and snails, with Alicante soap. Prout showed the value of fluid as a solvent in calculous affections; Chevallier, of alkalies; and Ch. Petit, more particularly of the Vichy springs. There can be no little doubt, too, that in the lithic acid form of stone, alkalies have an undeniable influence in checking their increase, if not in aiding their solution. In other stones they have no such influence.

Experiments of Dr. Roberts.

Dr. Roberts, who has in recent years paid much attention to this subject ('Med.-Chir. Trans.,' 1865), seems to think that "the results obtained by his experiments demand a considerable modification of the prevailing opinion regarding the inutility of the solvent treatment; they suggest an essential improvement in the treatment of *renal* calculi; they indicate that uric acid and cystine, under certain circumstances, are capable of solution in the bladder, by means of alkaline salts administered by the mouth, at a rate which admits of practical application; and that in picked cases a solvent treatment deserves to be resolutely tried." He adds, however, "that the solvent treatment is only applicable in those cases of vesical calculi in which the urine is acid, the stone not large, its composition known to be uric acid, or strongly suspected to be such." The best solvents are the acetate or citrate of potash, sufficient doses being given to make the urine *neutral*, not *alkaline*.

Garrod has suggested, as the results of experiment and experience, that, as in herbivorous animals, the presence of hippuric acid in the urine holds uric acid in suspension, so the administration of hippuric or benzoic acid might be of use. He has found this to be the case. He gives benzoate of soda in twenty-grain doses three times a day, and continues it with some alkaline citrate if the urine be very acid. I have found this treatment very efficacious in diminishing the amount of uric acid in the urine.

Injections into the bladder.

Brodie showed that the injection into the bladder of a solution of nitric acid, two or three minims to the ounce of water, had the power of dissolving phosphatic calculi; and, upon this suggestion, other experimenters have tried other fluids, such as weak alkaline solutions, for uric acid calculi, carbonate of lithia, borax, and acetate of lead, &c.; but there is this great disadvantage in the practice, that the solutions are apt to irritate the bladder, and thus do more harm than good. In the uric acid and oxalate of lime calculi they are almost useless. In the phosphatic stones most Surgeons admit the value of the practice, a solution of diluted nitric acid, ʒij to a pint of water, injected into a bladder, where phosphates are being deposited, being of great value in many cases. Such a practice must, however, be carried out with great caution.

Galvanic battery.

The aid of the galvanic battery has been employed to break up stones by Dr. Bence Jones, Sir W. O'Shaughnessy, and others; but the success attending the experiments has not been sufficient to warrant the recommendation of the means.

Small stones may often be washed out of the bladder by means of the urine; and patients who are prone to the passage of renal calculi into the bladder, and to the formation of lithic acid or other gravel, should be directed, once a day, when the full bladder is about to discharge its contents, to arrest the flow of urine by holding the penis, and then suddenly to allow the stream to flow; in this way the water, passing with a rush, carries away any small stone or sand that might be resting in the bladder. I have known this practice to be followed by good success. Old men should do this on their hands and knees. When a stone is too large to pass in this way it must be removed, which is to be done by means of lithotomy or lithotrity.

Small calculi may pass with a full stream.

Lithotomy or Lithotrity in cases of Stone.

Stone in the bladder in children may be safely treated by lithotomy, which should be performed as soon as the stone has been detected in the bladder, for the dangers of any individual case can be fairly measured by the size of the stone and the duration of the symptoms. The longer a calculus has existed, the greater are the probabilities of renal disease complicating the case; and the dangers of lithotomy, independently of its own special risks, are mostly due to the kidney affection. When the stone is large the neck of the bladder may be so injured by its removal as to set up a fatal peritonitis, and hæmorrhage may, in exceptional cases, cause death; but in skilful hands the operation of lithotomy, in patients under puberty, is most successful.

Lithotomy in children.

Sir W. Fergusson informs us, in his College Lectures, that out of fifty cases of lithotomy in children, he lost only two. In my own practice, out of the same number of cases under puberty, I have lost but two. In one the stone was two ounces in weight, and two inches in diameter, and the patient, ten years old, had had symptoms all his life, and incontinence of urine for four years. He died from peritonitis and extreme disorganisation of the kidney. In the other the child was three years old. The stone was removed without difficulty and without bleeding, and convalescence seemed at hand, when on the seventh day secondary hæmorrhage occurred, and death took place from convulsions.

Statistics favorable.

In children, therefore, it may be safely asserted that success may with some confidence be looked for after lithotomy, when performed with care and skill. "It may reasonably be doubted if better can be done before fifteen than cutting for stone."—*Fergusson.*

Lithotrity in a child, with fine instruments, may be a justifiable operation in exceptional cases when the calculus is known to be very small; but, as a rule, in patients under puberty, lithotomy ought to be selected. In Great Britain this practice is generally followed by Surgeons; although in France, lithotrity is more frequently selected.

In stone in the bladder in adults, its removal by lithotrity ought primarily to be entertained, and lithotomy had recourse to only when lithotrity is inapplicable. Lithotrity, as now practised, is, thanks to Bigelow, probably applicable to at least four fifths of all cases of stone in adult subjects. The danger of lithotomy rapidly increases with age, the mortality being one in eight between seventeen and forty, one in

Lithotrity to be preferred in adults.

four above that age. I have cut twenty-four adult male subjects with six deaths, or one in four; and Thompson, out of seventy-eight cases, lost twenty-nine, or one in two and three quarters.

When renal disease can be made out as existing, lithotrity is no more favorable an operation than lithotomy; when with it there are bladder complications, the cutting operation is probably the right one to adopt, even if only as a means of giving relief, although, when the stone is small and the renal symptoms uncertain, lithotrity may be undertaken with success.

Lithotrity not applicable in severe bladder mischief.

When *severe* bladder mischief complicates the case, lithotrity is out of the question, and lithotomy should be selected, although experience confirms what C. Hawkins has stated, that lithotrity may be performed with success when the bladder has been in a very considerable state of irritation, and secreting much ropy mucus. The irritation and the secretion of mucus cease when the whole of the calculus has been removed.

When paralysis of bladder.

When enlarged prostate.

Paralysis of the bladder does not preclude the practice of lithotrity, though it necessitates extra care and gentleness in manipulation. An enlarged prostate, unless mechanically interfering with the introduction of the instrument, is by no means an inseparable bar to the operation.

When a severe organic urethral stricture exists lithotrity may be impossible unless the stricture can be fully dilated. When the stone is very large the operation of crushing may be out of question. I have, however, crushed a lithic acid calculus 1½ inch in diameter with success.

Key's remarks on lithotrity and its advantages.

"Formerly," wrote Aston Key (1837, 'Guy's Reports'), "patients labouring under calculous disorders entertained a feeling of dread, almost amounting to horror, at the idea of having a stone in the bladder But since the introduction of lithotrity they no longer entertain the dread of their symptoms depending on the presence of a stone, and when the stone is found they cheerfully make up their minds to undergo an operation, which they regard as free from danger, and nearly so from pain. I have known a patient, and more than one, to be pleased with the discovery of a stone in the bladder, convinced, as he expressed it, that he could look for an easy cure from the new operation. The exaggerated statements of the advantages of lithotrity have, thus, not been unattended with good; they have been the means of inducing persons to come forward to obtain relief when the disease was incipient and the stone small. Since the introduction of lithotrity the Surgeon examines the bladder with great care, knowing the importance of discovering the calculus at the earliest period. The early symptoms of stone are thus watched with more jealousy on the part of the Surgeon, and are not so scrupulously concealed by the patient. The advantages of an early knowledge of the existence of a stone, and of prompt measures for its removal, are known to both. The result of this is, that patients apply for advice when the stone is small, the bladder uninjured by its presence, and the kidneys free from disease. In three persons out of four who apply for advice for symptoms of calculus, the size of the stone and the conditions of the viscus render lithotrity an easy and a safe operation."

These extracts which I have given from Aston Key's paper, written nearly fifty years ago, might have been from the pen of a more recent writer, they so accurately represent the advantages of what was then called the new operation, and prove how the great Surgeon who wrote them recognised its value. What Key would have said of Bigelow's still newer method can easily be surmised.

Summary.

Summary.—It would thus appear that in *children*, lithotomy ought to be the rule, and lithotrity the exception. In *adults*, lithotrity ought to be the rule and lithotomy the exception—the latter operation being selected only when the former is impossible from some urethral or prostatic irritability or mechanical obstruction, severe bladder disease, or a large stone. Renal disease in all cases renders doubtful the prognosis of any operative procedure, the weight of evidence tending in favour of a cutting rather than a crushing operation under such circumstances, though when the stone is small, lithotrity is not precluded.

When palliative treatment to be adopted.

In cases in which neither operation can be recommended, or when both are rejected, it is wonderful how long patients, the subjects of stone and organic disease, by care and good advice will live, and how little irritation a calculus sometimes causes; and though the knowledge of this fact should not induce a Surgeon to leave alone a patient who has a stone, it is enough to enable him to give hope and encouragement to one whose life would be endangered by any surgical attempt at its removal; for palliative treatment is, doubtless, a source of great comfort and a valuable means of prolonging life.

LITHOTRITY.

On lithotrity. Opinions respecting it.

"In the whole of my professional experience," says Fergusson in his College Lectures, 1867, "I know not of a useful operation which has been so shamefully overpraised, and thereby damaged in character as lithotrity. I know not any process in surgery requiring more forethought, knowledge, manipulative skill, and after-judgment." "Nor is it possible," writes Thompson, "to conduct all the manipulations with too much care and gentleness." These opinions, emanating as they do from two of such experienced lithotritists, ought always to be remembered, since they are true to a degree that Surgeons only who have had some experience in the operation can appreciate. To Mr. Elderton, a Northampton Surgeon, is due the merit of being the first to construct an instrument for the purpose of crushing a calculus, and enabling the patient to pass it by the urethra ('Edin. Med. and Surg. Journal,' April, 1819); but lithotrity was first realised as an operation and successfully practised by Civiale in 1824, and to him the profession is chiefly indebted for the operation, though Leroy d'Etiolles, Heurteloup, Amussat, and others did much towards favouring the practice. It is probably, however, to Heurteloup that British Surgeons are mostly indebted, as he came over to England about 1829 and explained fully to the profession the mechanism of his improved instruments and the steps of the operation, and, on the invitation of Mr. Aston Key, this instruction was given in the theatre of Guy's Hospital. Weiss, in 1823, had previously devised a screw lithotrite, and, after Heurteloup's visit, and probably from information acquired through him, so improved it, that all modern instruments are based upon that which he then introduced. Aston Key, Brodie, Costello, Hodgson Fergusson and others subsequently practised the operation,

When first performed.

Literature of the subject.

and, upon the result of their experience with that of Civiale, the operation has become a recognised one, the instruments employed having been vastly improved, and their use better understood.

In 1829 Aston Key read a paper on lithotrity at the Hunterian Society, and the report of a successful case, and in 'Guy's Reports' for 1837 will be found a masterly paper upon the subject by the same Surgeon. In 1834 Fergusson wrote on lithotrity in the 'Edin. Med. and Surg. Journal,' in which he introduced his rack lithotrite, and to him, as well as to Sir B. Brodie, Sir H. Thompson, and Charles Hawkins, most of our modern improvements are due.

Bigelow's operation.

The greatest improvement, however, was left for H. J. Bigelow, of Harvard, United States, who in 1878 introduced to the notice of Surgeons his rapid method of crushing stones, and of evacuating their *débris;* since which time it may be said, with all truth, that a new starting-point for the operation has been supplied. It is true that the full credit of this operation must not be given entirely to Bigelow, since something is due to the introduction of anæsthetics; something to the principle embodied in Crampton's bladder evacuator, introduced in 1846, and in Clover's of a more recent period; something also to Otis, who in 1874 demonstrated the fact that the normal urethra will bear fuller dilatation than it had hitherto been subjected to; nevertheless, it was left to Bigelow to see fully the bearing of all these points, and so to focus them, as it were, upon the operation of lithotrity, as to make the rapid method a positive success; the method depending upon the tolerance of the bladder; the use of larger lithotrites, and, above all, the employment of large catheters, and of a more powerful evacuator than Clover's. "The new and essential instrument of the operation," writes Bigelow, "is the large catheter, 25 to 31. This is indispensable. The small size of the previous evacuating catheter delayed surgical progress for half a century."

The Operation.

The objects of lithotrity may now be defined as, first, to reduce a stone to fragments sufficiently small to pass through *as large* an evacuating catheter as can be introduced into the bladder without injury to the bladder and passages; and, secondly, to remove the fragments as speedily as possible.

Preliminary treatment.

Preliminary treatment.—Starting with the assumption that our patient is fairly healthy, the stone of reasonable dimensions, that is, not more than 1 or 1½ inches in diameter, and not too hard; the urethra of normal size; bladder capable of retaining about four ounces of not unhealthy urine—conditions under which operative interference ought to be most favorable—it is always well to keep the patient quiet for a few days, and to test the urethra and bladder as to their capabilities of bearing the mechanical irritation of large instruments by the introduction of a sound; attention should be paid at the same time to the condition of the secretions, &c. With every attention, however, it is not uncommon to meet with cases in which the mere passage of a sound is followed by severe local and constitutional disturbance, and in lithotrity such a complication is most detrimental. On the other hand, where irritability exists, the occasional introduction of an instrument is often followed by relief.

When the bladder is inflamed and irritated by the presence of a stone, rest is most essential, with the use of alkalies and the decoction of the Triticum repens, or other drugs suitable for cystitis. When the urine is ammoniacal the bladder should be emptied, and washed out.

By these means the symptoms may subside and the bladder become capable of retaining sufficient urine—four ounces—to allow of the operation being performed, where previously it would have been impossible.

Preparation for operation

The patient having been prepared for operation by the treatment just laid down, the bowels cleared by a mild aperient or an enema the day before, and the bladder sufficiently distended by the patient retaining his urine as long as he conveniently can before the Surgeon's visit, or the injection into it of a lotion of thymol or boracic acid, the operation may be proceeded with.

Position of patient.

Operation.—The patient should be placed upon a firm horsehair mattress or sofa, with his right side near its edge; his shoulders should be low, and pelvis raised by means of a firm pillow, and the knees slightly flexed and separated, care being taken that only such portions of the pelvis are exposed as are necessary to allow of the Surgeon's manipulation, for a sudden chill often acts upon the bladder, and induces it to contract and expel its contents.

The object of raising the pelvis is to roll the stone backwards from the neck of the bladder, its most sensitive point.

An instrument with large teeth and a fenestrated female blade is the best for crushing large stones (Fig. 346 A), and a less powerful instrument with finer teeth, for small stones or fragments (Fig. 346 B).

Introduction of instrument.

The instrument selected by the Surgeon, according to the size of the stone to be crushed, having been previously well warmed and oiled, is then to be carefully introduced, no force being employed; indeed, it may almost be allowed to slide into the bladder by its own weight, the Surgeon simply guiding it.

When the instrument has reached the prostate, and not before, the handle of the instrument is to be depressed towards the patient's thighs, when the blades rise up into the bladder, "a movement which is rendered more easy," says Thompson, "if a very slight lateral rotary motion is given to the instrument at this part of its progress."

Mode of seizing stone.

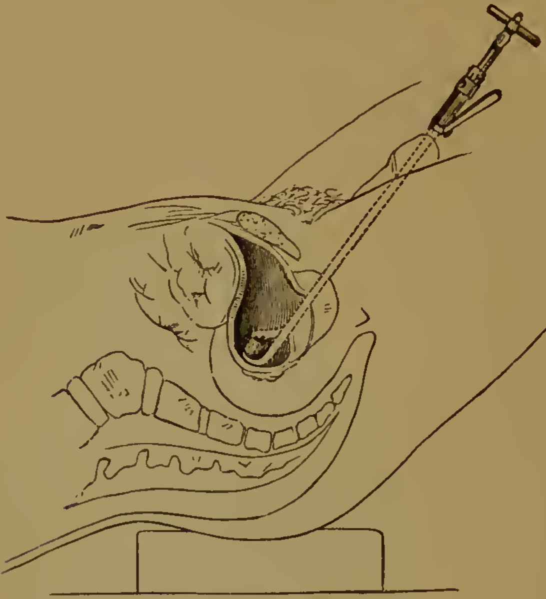
The bladder thus reached and the instrument pressed well into the organ, the object is to seize the stone, which can either be done by so depressing the lithotrite with its open blades as to allow of the stone falling between them, or by turning the open instrument to the stone and picking it up. The *first* is the older and the more usual method, and the one I have commonly adopted; the *second* is useful where the stone is not readily found by the first method, where the prostate is enlarged, and the stone rests in a hollow behind it. In either method the movements of the instrument are to be gentle and quiet, and care is to be observed that in opening the instrument the male blade does not injure the neck of the bladder.

Finding and Seizing the Stone.

Thompson's description.

"Let it be understood that the blades of the lithotrite have entered the cavity of the bladder, and that the instrument slides easily and smoothly down the trigone, which in the living and healthy organ is an inclined plane, although quite otherwise in the atonied and in the dead bladder. In many cases the instrument in thus passing grazes the stone, and the slightest lateral movement of the blades, right or left, will determine on which side it lies. Whether the stone is felt or not, when the blades have passed gently down in the middle line until a very slight check to their movement is perceived, the lithotrite should rest there for three or four seconds, and then the male blade should be slowly withdrawn, without moving any other part of the instrument, towards the neck of the bladder, until a very slight check is perceived in that direction, followed by another three or four seconds' rest for currents to subside. Now the operator should quietly press back the male blade without changing the position of the lithotrite, and almost certainly the stone will be seized. In other words, open; pause; close—that is all."

Fig. 344.

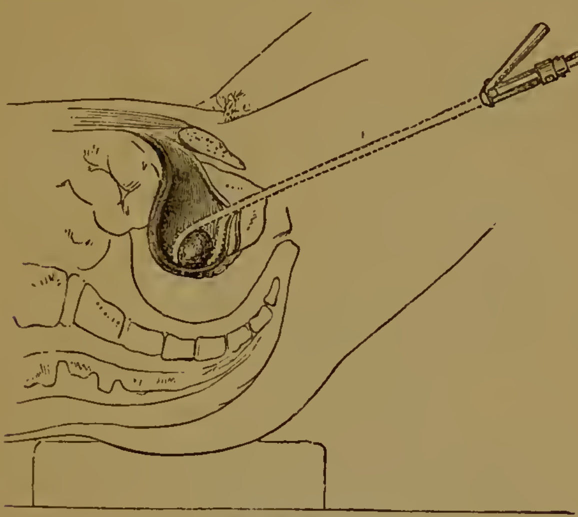


Operation of lithotrity.

Thompson's further description.

"If no stone is thus found, the operator again withdraws the male blade as before, but inclining to the right side about 45°, and closes without disturbing the central position of the instrument. If no stone is felt, he then turns them, opened, to the left in a similar manner, and then closes them. Thus, in almost all positions, the stone is seized sideways by the blades of the lithotrite, and very rarely by their extremities. Observe, *that the blades are always to be opened before they are turned, for this reason; if the turn is first made and the blades are subsequently opened, the chance is that the male blade, as it is withdrawn, will move the stone away; whereas, if the blades are inclined while open, the stone, if there, is almost certainly seized.* This is one of the many apparently minute but extremely important points of which systematic lithotrity is made up. To return, it is very rare that the stone will elude the search thus far, but if it does, depress the handle of the lithotrite half an inch or so, which raises the blades very slightly from the floor of the bladder, and turn them another 45° to the left, bringing, in fact, the blades horizontally to the left; close; if unsuccessful, turn them gently to horizontal on the right, and close. In all these movements, if properly executed, there has been barely contact of the lithotrite with the vesical walls; at all events no pressure, nothing to provoke undue pain, or cause contractions of the bladder. If, however, there is an enlarged prostate, causing an eminence at the neck of the bladder, or depression behind it, or the stone is very small, or we are exploring for some fragment, at the close of the case, which is suspected to have eluded previous search, the blade may be reversed so as to point downwards to the floor, and the object sought may then often be secured with ease. If seeking for a small stone or for fragments, we may employ a lithotrite with short blades, which can therefore be reversed with much greater ease than one with long blades.

FIG. 345.



Operation of lithotrity.

When seeking for small stones.

"In order to do this properly, the handle of the lithotrite is depressed another inch or so between the patient's thighs, so that the shaft of the instrument, instead of being directed a little upwards, is level with, or points below, the horizon; the blades, being still closed, are cautiously brought round to the reversed position, and the floor first lightly swept in the manner of a sound in searching for stone. Then they may be carefully opened and closed two or three times, in slightly varied directions, but without injuring the floor of the bladder. When the prostate is considerably enlarged, and a stone or fragments have to be sought behind it, the lithotrite is reversed without depressing the handle.

When enlarged prostate.

"All these movements are to be executed at or beyond the centre of the vesical cavity, the proper area for operating, without hurry, rapid movement, or any other which partakes of the nature of a jerk or concussion, and, if in a fairly healthy bladder, without causing more than

Civiale's instructions in manipulating the lithotrite with blades.

a very slight degree of pain to the patient. The operator's eye is also to be so familiar with the scale marked on the sliding rod, that he knows at a glance the exact interval which it indicates as existing between the blades in the bladder. It is essential to good practice, while manipulating the lithotrite, to maintain the axis of the instrument as far as possible always in the same direction. The blades only are to be moved; the shaft should occupy the same inclination, unless when this is intentionally altered. In screwing home the small blade the operator is very apt to move the lithotrite also at each turn of the screw, unless he is conscious of the care necessary to avoid the evil. *All lateral movements, all vibration and concussion, necessarily tell on the neck of the bladder and prostatic urethra,* where the instrument is most closely embraced and its mobility is most limited. To that part of the lithotrite which occupies the anterior portion of the urethra much freedom of lateral movement is permitted, and in the bladder the instrument is free, although in a less degree; but the axis or fixed point, as regards lateral movement, is at the part indicated, which is also the most sensitive spot of the entire passage. Hence the aim of the operator should be to produce in this situation no motion of the lithotrite except that on its own axis. Few of the details of the operation require more practice to master than this.

Lithotrite should only move on its own axis.

"A rule has been laid down with reference to the situation of a calculus in the bladder. It is said that the larger the stone, the more certain is it to be found lying near to the neck of the bladder in the ordinary recumbent position, while a small one is usually detected at the back of the trigone. Without assenting to the accuracy of this remark, at all events, in relation to the small stone, which is often close to the vesical orifice, it may be said here that the act of seizing a large stone in this position requires consideration. For if the operator commences by withdrawing the male blade according to the ordinary custom, this blade is apt to be drawn against a large stone, which it therefore fails to catch, and presses it back against the neck of the bladder, doing mischief and not succeeding. As a general rule, it may be said that the most common cause of failure to seize a large stone arises from its close proximity to the neck of the bladder (whatever position is given to the patient), and from the male blade being drawn up against it, at each opening of the lithotrite in the manner just described. In these circumstances the operator feels the contact of the stone without suspecting its precise locality, each time he withdraws the blade, and is apt to feel embarrassed on failing to seize it when he closes immediately after. In these cases it is essential to draw the male blade gently, but closely, to the neck of the bladder, and to slide the blade between the neck and the stone which lies in contact with it."

"The rules laid down for finding and seizing apply more or less to lithotrites of moderate size, but this general rule may be borne in mind, viz. the more powerful the lithotrite—that is, the larger and longer are its blades—the less readily are we to adopt the reversed positions of the blades, and the more fluid is it desirable to have in the bladder. As large and fenestrated blades are used chiefly for the initial act of breaking up a large stone into fragments, it is obvious, also, that there is less occasion for the horizontal and reversed movements, since a large stone may almost certainly be seized by the right or left incline."

Crushing the Stone.

Crushing stone.

"Supposing that a hard stone of an inch and a half in diameter has fallen into the grasp of a powerful lithotrite, the screw is to be gradually turned at first, to make the blades bite, since a sharp turn at this moment may drive the stone out either right or left. As the power is increased, the resistance is felt to relax, sometimes by degrees, sometimes suddenly with a crack, and the stone is broken usually into four or five large pieces, besides some small *débris*. This done, the male blade is again drawn out, taking care not to shift the situation, or alter the axis of the lithotrite, and almost certainly one of the large fragments will be picked up. It is then only necessary to screw home, release the screw, and open as before. This process may be repeated several times, at the same spot, for the area within which the larger fragments fall is very limited, and is unchanged if all remains quiet. The large and heavy pieces fall invariably in the same place, and may be picked up again and again, if *this simple rule of keeping the* blades in one place is adhered to. Having now broken up the stone, and crushed well the largest fragments, and thus occupied perhaps from ten to fifteen minutes, it should be time to employ the aspirator and remove the *débris*. Accordingly, the screw of the lithotrite is driven well home, to close the blades, between which some calculous matter probably is engaged, and the lithotrite is withdrawn."

Removal of Débris of Stone.

Removal of débris.

The stone having been crushed has to be removed, and this is effected by means of a large catheter and powerful evacuation.

A No. 15 or 16 evacuating catheter for small, and a No. 17 or 18 for large stones should be selected and passed. The larger instruments, Nos. 25 to 30 as used by Bigelow, being required in very exceptional instances, the size being determined by that of the urethra. These are made of different curves (Fig. 346 C). The urine should then be withdrawn.

"An aspirator (Fig. 346 D) previously filled with tepid water is then attached, the connection tap opened and a small portion of its contents pressed by the right hand into the bladder, the left hand supporting and directing the evacuating catheter."

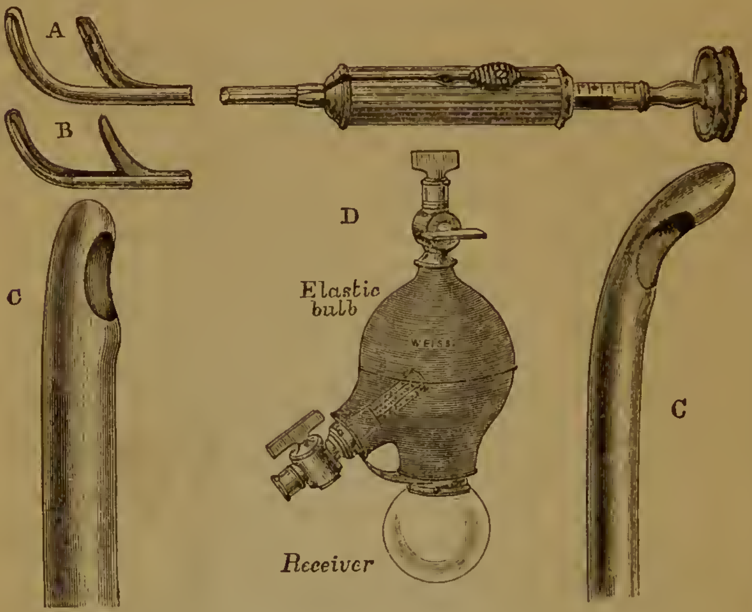
"On relaxing the pressure, an immediate current outward follows, carrying with it very probably a fair quantity of *débris*. Wait some three or four seconds after expansion has finished and the current apparently ceased, as at that precise time it is quite common for one or two of the larger fragments to drop into the receiver, which would have been driven back perhaps by too rapidly resuming the pressure. This process is repeated several times, according to the amount of *débris* observed to enter the trap. After a large crushing the end of the evacuating catheter should not rest on the floor of the bladder, as it is then likely to be choked with *débris*. But after most of the fragments have been removed, it is advantageous to lower the end of the catheter in order to catch the last fragments.

"If the outflow of the current is felt to be suddenly checked and the aspirator ceases to distend, the operator may be almost certain that a fragment of a rounded or cubicle form, or a small calculus, nearly fitting the interior of the catheter, blocks the passage and prevents

Thompson's description continued.

further egress. The piece must be expelled by making smart pressure on the india-rubber bottle, after which the action of the aspirator will probably be resumed.

FIG. 346.



Lithotrites, catheters, and evacuator required for Bigelow's rapid lithotrity.

"If after crushing all the stone, so far as the operator is able to judge, and removing the *débris* largely, nothing is heard or felt in contact with the end of the evacuating catheters, notwithstanding that three or four successive pressures have been made, there is ground for believing that all the fragments may now have been removed. Perhaps there can be no better proof that the bladder has been emptied than is afforded by the fact that a succession of outward and inward currents through the aspirator shows no sign either to the eye or to the ear of the presence of another fragment.

"If all has not been removed, the sound of a large piece perhaps making itself heard and felt at each outward current against the end of the catheter indicates that this must be withdrawn and a lithotrite introduced. If the fragments are not of considerable size a lighter and handier lithotrite may succeed with advantage to the heavy fenestrated one originally used, and the crushing continued. Of course if more stone remains, the process is repeated once or more. In from ten to forty or fifty minutes, however, a uric acid calculus of very considerable size may be thus broken up and removed."

After-Treatment.

After-treatment.

"When the patient has fully recovered from the anæsthetic—if suffering severely, say three or four hours after the operation, a condition, by the way, which is very uncommon—a hot bath, as hot as he can have it, for fifteen minutes, gives great relief. The treatment for the first three or four days in cases of large calculus is that of a mild acute cystitis; recumbent position, external warmth, frequent hip baths, and small but frequent doses of solution of potash, just to neutralise the acidity of the urine. If the urethra is over-stretched or bruised, an india-rubber catheter may be tied in for twenty-four hours or so, but this is not frequently necessary; while if the bladder had previously lost the power of emptying itself, such an inlying catheter for a day or two is mostly better than frequent catheterism."

After-treatment.

"As a general rule, we find during the three or four days immediately following the operation, that the relief is considerable, that the urine is clear, that the bladder tolerates a large quantity, and the aspect of the case is one of rapid and unchecked convalescence. But on the fourth or fifth day a little excitement is not infrequently observed, the bladder becomes irritable, the urine is cloudy, and after twenty-four hours or so subacute cystitis is established, often destined to be troublesome for a week or two. This liability indicates that it is most desirable to enforce the recumbent position, confinement to the room, a warm temperature (in cold weather), and care in every particular of management for at least some days after crushing a calculus, whatever its size."

A caution.

Complications.—When a fragment becomes impacted in the urethra and produces retention, it should either be gently pushed back into the bladder with a large catheter or removed with urethral forceps. These fragments not only produce retention at times, but epididymitis, from irritation of the caput gallinaginis.

Complications.

Should fever follow the operation, ushered in with a rigor, there is probably some slight lesion of the urethra. "In nine cases out of ten it is not of serious import, and is treated by keeping the patient warm, wrapping him up well, applying hot bottles, and giving some warm drink as hot tea or warm wine and water." A moderate dose of opium is perhaps the most useful prophylactic.

Occasionally the attack of fever announces the onset of a cystitis, testitis, or some renal complication.

Hæmorrhage is a rare complication. When present, by rest and cold it usually subsides.

Chronic retention of urine is a complication which is to be carefully looked for, since it occurs very insidiously: it is to be relieved by careful catheterism.

Sir H. Thompson reports that he has had 104 consecutive cases of rapid lithotrity in men averaging 62 years of age with only three deaths. This mortality, he adds, "is a better achievement than I had ever ventured to hope for" ('Holmes' System,' 3rd Edition, vol. iii).

LITHOTOMY.

In children, where lithotrity is inapplicable, and in adults, when lithotrity, for reasons already given, ought not or cannot be applied, lithotomy *must* be employed, and lateral lithotomy is doubtless the best, as it is the most usual operation. "In children it is difficult to mention any operation in surgery so uniformly successful as lithotomy is. The incomplete development, and the consequently little susceptibility of the parts involved—the small size of the vessels, and the little

Lithotomy in children.

risk of hæmorrhage—the yielding nature of the textures, rendering force unnecessary in the extraction of the stone—are circumstances that combine to divest the operation of much of the danger that surrounds it when performed in the adult. From childhood to the age of puberty the dangers can hardly be said to increase. Boys of thirteen years of age suffer scarcely more from the operation than children, and for the same reason. Seeing, then, that so little risk and suffering attends lithotomy in children, it is difficult for us to find an equally safe and efficient substitute; it can scarcely, indeed, be said to be required."—*Aston Key.*

ithotomy in dults.

In the adult male, lithotomy is rarely resorted to until the Surgeon becomes convinced that the removal of the stone by lithotrity is inapplicable, or has failed; at least, such has been the practice at Guy's Hospital for many years, and, taking the average of cases of stone in the adult admitted, half only have been subjected to lithotomy. In private practice, the proportion of cases of lithotomy to lithotrity is much smaller, patients applying for advice at an earlier period. From this fact, the worst cases of stone are alone submitted to the cutting operation, and, as a consequence, the mortality is high. At Guy's, lithotrity being the rule in adults and lithotomy the exception, the mortality of the latter operation in adults is one in three, whereas in places where lithotrity is little practised, it is one in five.

ortality fter ithotomy.

"It is probable," writes Birkett, 'Guy's Rep.,' 1867, "that the rate of mortality after lithotomy must henceforth always appear higher than formerly, in consequence of so many of the patients suffering with stone who might have been cut successfully, being those now selected for the performance of lithotrity. In point of fact, the very cases which swelled the list of successful results no longer appear in the category of those submitted to the cutting operation; but, on the contrary, those patients too ill to recover from lithotrity frequently, as a last resource, submit to lithotomy and perish."

ateral ithotomy.

Lateral Lithotomy, or the operation of Raw, Jaques, and Cheselden is, without doubt, the favourite means of extracting a stone from the bladder among modern surgeons, assuming that lithotrity is inapplicable or inadvisable. As an operation, it has been nobly planned; and to see it performed with skill and precision is still a sight which affords gratification to the youngest as well as the oldest Surgeon. In my student days, to see Aston Key cut for stone was an event which I now fondly think over with pleasure and admiration; and the memory of the skill and precision of his acts in this, as in all other operations, is still before me as a standard of perfection at which all should aim.

Key's peration.

These remarks are not inapplicable as a preface to the subject of lateral lithotomy; for Key's use and advocacy of the straight staff in that operation have so influenced all his successors that up to the present day "Key's" operation is the one usually performed at Guy's, the exceptions to this rule being so rare as not to be named. The success which has attended this practice has been very good; when, indeed, compared with that furnished from other sources, it seems so remarkable that it is difficult to arrive at any other conclusion than that the mode of operation has something to do with it; for taking the most reliable statistics—the Norwich 408 cases, in subjects under puberty, and Thompson's 868, eliminating the Guy's cases—the mortality was

Statistics.

1 in every 14½ cases; whilst of Guy's cases and Key's operation during seventeen years it was 1 in 57 cases, 3 deaths only having occurred in 171 cases, the success of Key's operation being four times greater than that of others.

Statistics in children. In children under five years of age, these points are still more strongly marked, as out of 400 cases tabulated by Thompson, the mortality was 1 in every 13½; the Norwich not being quite so good; whilst at Guy's after Key's operation, in my old table, it was 1 in 23½ out of 73 cases, and *more recently, during seventeen years, ending in* 1874, 100 *patients have been cut consecutively without a death.*

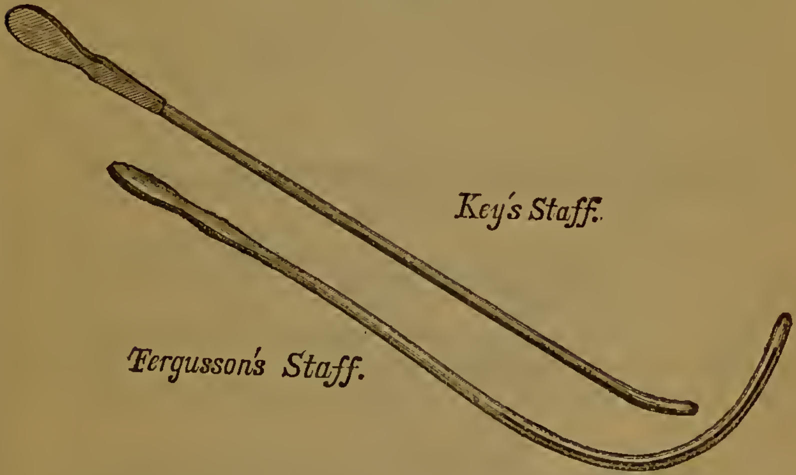
In the nine years ending 1882, the results were not quite so good, as one child, æt. 3, died on the fifth day from convulsions after secondary hæmorrhage when he was thought to have been convalescent, out of 15 cases operated upon.

This success is certainly more striking than I anticipated when I began the comparison, and must in a measure, if not altogether, be ascribed to the greater safety of Key's operation.

Description of Key's operation. I propose now to describe the operation of lateral lithotomy, and I shall do so after what I believe to be the best method, that of "Key," giving also that with the curved staff. But first of all, as to the instruments required.

Instruments. The staff, whether straight, as in Key's operation, curved (Fig. 347), or rectangular, as in others, must be regarded as a director. It is a means the Surgeon employs to guide his knife into the bladder, and I may say with Key that "the advantage of a straight over a curved line as a conductor to a cutting instrument is too obvious to require any comment. Is it surprising that the blind should err in a crooked path?" Key's staff is blunt-pointed as a sound, and more deeply grooved than the common staff, to prevent the risk of the knife slipping out; the groove is in the centre of the staff, not at one side, as in the ordinary curved one, and it runs to within half an inch of the end. "Its chief superiority," writes Key, "consists in allowing the Surgeon to turn the groove in any direction he may wish."

FIG. 347.



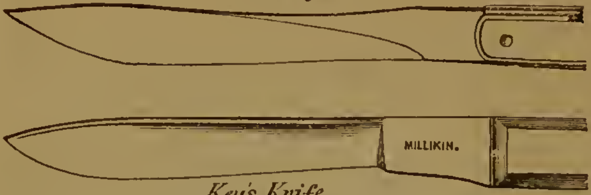
Staff.

The staff must vary in length and size, according to the age of the patient and size of the urethra, it being well to use as large a one as will pass readily down the urethra.

Knife. The knife varies much with the fancy of the operator. That employed by Key (Fig. 348) and his successors resembles in form a common scalpel, but is longer in the blade, and slightly convex in the back near the point, to enable it to run with more facility in the groove of the director. Different sizes are required for a child and an adult.

Fig. 348.

from Fergusson



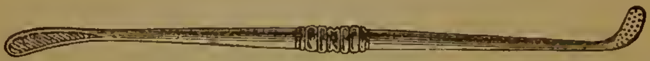
Key's Knife.

The knife as employed by Sir W. Fergusson (Fig. 348) is given as a type of that required for the curved staff.

A probe-pointed bistoury or blade with a round point is sometimes of use to enlarge the vesical opening when not made free enough, or to give vent to a large stone.

Forceps. Lithotomy forceps should be made of several shapes and sizes, and a scoop (Fig. 349) ought also to be at hand. It is used by passing it behind the stone, and fixing it there by the pressure of the left index-finger, the instrument with the two hands being withdrawn with the stone.

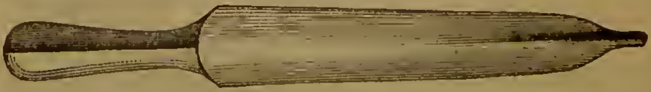
Fig. 349.



Lithotomy scoop.

Blunt gorget. When the perinæum is very deep, and some extra guide is required by the Surgeon for the introduction of his forceps into the bladder and the extraction of the stone, the blunt gorget (Fig. 350) may be used, the instrument, guided by its beak, being passed into the bladder upon the staff, and upon this the forceps can readily be introduced.

Fig. 350.



The blunt gorget.

The gorget is never needed in children, but in adults it is often of great use.

Preparation for operation.—The bowels should be well cleared out by a dose of castor oil, given some hours previously, and the rectum emptied by means of an enema the morning of the operation, care being taken that the enema has returned. The perinæum should likewise be shaved.

The Operation.—The Surgeon having decided upon his operation, selected his instruments, and seen that he has at hand everything he may require, having also obtained the help of three if not four assistants, besides the anæsthetist, proceeds to place his patient.

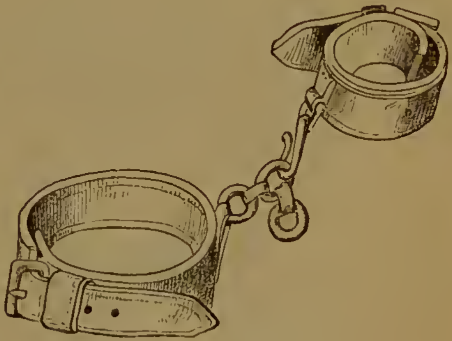
Position of patient.

A narrow but well-raised table should be employed, so that the patient's perinæum and the Surgeon's face should be nearly on the same level. The patient should be placed on his back with his thighs flexed upon the pelvis, and the legs upon the thighs, the hands of the patient being made to grasp his feet, and fastened in such a position by the figure-of-8 bandage, the padded bracelets and anklets, as seen in Fig. 351, or Clover's crutch. Children need not be fastened, but it is more prudent for adults; although some Surgeons, since the introduction of anæsthetics, have given up the practice under all circumstances. The shoulders should be well raised, the knees separated, and the pelvis kept well down upon the table by two assistants; the Surgeon should also see that the patient is quite straight, the line of the umbilicus being the best guide to this position. *The perinæum should be perpendicular.* The Surgeon may then pass the staff, and having introduced it well into the bladder, and felt *as well as heard* the stone, he is to entrust it to the hands of an assistant, one who can confidently be relied upon to hold it in the position in which the Surgeon has placed it, and who will not draw forwards in any degree. This point is of importance, for there is good reason to believe that many of the mishaps connected with the operation are due to the staff having been partially withdrawn from the bladder by an assistant, who perhaps in stooping forward, tries to get a sight of the operator's movements.

Perinæum to be perpendicular.

Position of staff.

Fig. 351.



Lithotomy bracelets.

When the straight staff is used, it is to be held well up, with the handle slightly tilted towards the operator; and, when the curved staff is employed, some Surgeons like it to be well hooked up against the symphysis, but, under all circumstances, it is to be held steadily.

First step of operation.

First step.—The Surgeon having ascertained the size of the prostate through an anal examination, may then proceed with the *first step* of the operation, viz. to lay bare the staff, or director that is to guide his knife into the bladder; and the point at which this opening is desired is *at the membranous portion behind the bulb and in front of the prostate;* Blizard, Martineau, Stanley, Key, and Fergusson, all lay stress upon this important point. With this view, the perineal incision is to be made, and in lateral lithotomy, the line of incision lies from the left

Perineal incision.

of the median line of the perinæum downwards, backwards, and outwards, midway between the anus and the left tuber ischii. The incision is usually from three to three and a half inches long. Some Surgeons commence the cut an inch in front of the anus, others fix it at one and a quarter to one and three quarters; but this point is not one of primary importance. The object of the incision is to make a free external opening, to enable the Surgeon to reach the groove of the staff at the part indicated, and allow subsequently of the removal of the stone; a point midway between the scrotum and anus is probably the best to start from; the length of the perineal region varying greatly in different subjects.

In making this perineal incision, the left thumb of the operator should be firmly fixed above the point at which the knife is to be introduced; and it is well for the Surgeon with the left fingers to hold the staff firmly at the root of the penis at the same time. The point of the knife may be well introduced into the soft parts in the line of the director, and the tissues freely divided in the cut downwards, a second or third touch of the knife being made to complete the section. If these be made too low the rectum is liable to be wounded. In this incision the perineal triangle and ischiorectal space are laid open, and the skin and fascia with the transverse perineal muscle and its artery divided.

Second step of operation.

Second step.—The Surgeon having exposed the groove of the director (staff) that is to guide his knife into the bladder, should then proceed to the *second step* of the operation. For this purpose when the curved staff is used, he should introduce the forefinger of his left hand into the wound, and feel for the staff *behind and to the left of the bulb, and having clearly made out the two edges of the groove and run his nail between them,* he should introduce the point of his knife upon the nail of the finger into the groove, and having clearly divided the tissues sufficiently to make him confident that the point of the knife is well into the groove of the staff, complete his deep section by pushing the knife along the groove of the staff into the bladder, lateralising it to divide the left lobe of the prostate and neck of the bladder sufficiently (Fig. 352).

In Key's operation.

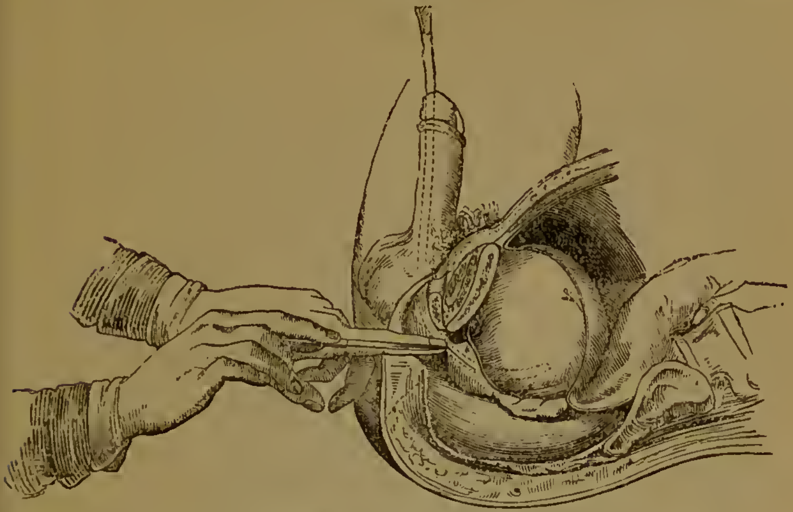
"The point of the knife in Key's operation being kept steadily against the groove, the operator with his left hand takes the handle of the director, and lowers it till he brings the handle to the elevation described in Fig. 353, keeping his right hand fixed; then with an easy, simultaneous movement of both hands the groove of the director and the edge of the knife are to be turned obliquely towards the patient's left side; the knife, having the proper bearing, is now ready for the section of the prostate; at this time the operator should look to the exact line the director takes, in order to carry the knife safely and slowly along the groove, which may now be done without any risk of the point slipping out."—*Key*.

Section of prostate

"In the majority of cases it will merely be necessary to pass the knife along the director, and having cut the prostate to withdraw it without carrying it out of the groove, varying the angle according to the age of the patient, the width of the pelvis, and size of the stone. As the direction in which the prostate should be divided, in order to adhere to Cheselden's operation, is obliquely downwards and outwards, increasing the angle at which the knife enters the bladder will incur no risk of wounding the pubic artery. The knife may be conducted with deliberate care into the bladder, the resistance afforded by the prostate will be readily felt, and the hand of the operator should be checked as soon as he feels the prostate has given way."—*Key.*

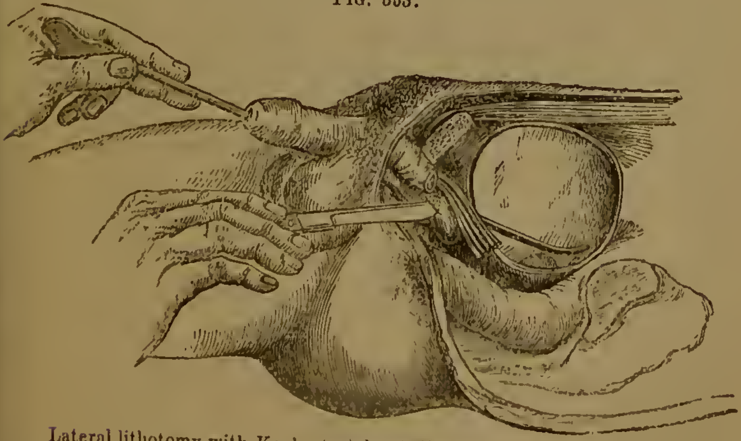
The Surgeon knows when he has entered the bladder by the absence of resistance, and occasionally by a rush of urine. He should remember, however, that some urine will escape so soon as the urethra has been opened, and not be misled by the fact. The angle which the knife makes with the staff regulates the size of the incision into the neck of the bladder. When the knife is in a line with the staff the incision will be limited; the larger the angle the knife makes with the staff, the larger will be the wound.

Fig. 352.



Lateral lithotomy with a curved staff.

Fig. 353.



Lateral lithotomy with Key's straight staff. Taken from Key's works.

Size of wound.

As a rule, a large wound can be of no advantage unless the stone is very large. A small wound, however, is a disadvantage when the stone is of medium size; for although the neck of the bladder is capable of a good deal of dilatation under moderate force, any severe laceration of the prostate is almost certain to be followed by bad results. Surgeons differ much upon this point, some recommending dilatation in preference to free incisions into the neck of the bladder, whilst others prefer free division of tissues rather than run the risk of lacerating them.

Dilatation of wound.

Moderate dilatation is certainly free from risk; while severe dilatation is dangerous, inasmuch as it necessitates great laceration. As a rule the incision should never exceed the limits of the prostate.

Third step of operation.

Third step.—The bladder having been opened, the third step of the operation remains to be performed, which consists in the removal of the stone. This is to be done by means of forceps.

Points to be attended to.

The knife having been withdrawn on the completion of the second step, the index-finger of the Surgeon's *left* hand, guided by the staff, should be introduced through the wound into the bladder; and the operator ought always to remember that, *till the finger has been fairly passed into the bladder upon the staff, this instrument is not to be withdrawn;* although when the bladder cannot be reached by the finger the blunt gorget may be passed along the staff to act as a guide to the forceps. The forceps, held in the Surgeon's right hand, is then passed into the wound upon the left index-finger, and, guided by it, pushed into the opening, the forceps being introduced into the bladder at the moment the finger is withdrawn.

Guide for forceps.

Introduction of forceps.

"Having delivered his knife to the assistant, the operator, in 'Key's' operation, takes the staff in his right hand, and passing the forefinger of his left along the director through the opening in the prostate, withdraws the director, and exchanging it for the forceps, passes the latter upon his finger into the cavity of the bladder."

"In extracting the calculus, should the aperture in the prostate prove too small, and a great degree of violence be required to make it pass through the opening, it is advisable always to dilate with the knife rather than expose the patient to the inevitable danger consequent on laceration."—*Key.*

Forceps and mode of using.

The forceps should be full-sized, and introduced into the bladder closed *flat upon the stone,* and immediately opened, the stone generally being at once caught in the blades, the rush of urine carrying it towards the wound. The stone should be grasped boldly, and, when seized, be slowly and deliberately extracted, the extracting force being made in the direction of the axis of the pelvis *downwards* and backwards, and then forwards; a little rotatory and side-to-side motion of the instrument at times facilitates the extraction of a calculus, the Surgeon at the same time with his index-finger pushing the soft parts off the stone. Before extracting, the operator, by the sensation given to the forceps, will assure himself that the bladder is not caught.

Difficulties.

It is in this third step of the operation that the Surgeon frequently meets with his difficulties, and much discretion and fertility of resource are often needed to overcome them, since no definite rules can be laid down as a guide. The stone may elude the grasp of his instrument; sometimes it clings to the bladder above the wound behind the symphysis, and is thus without the reach of the instrument; at others, it is caught above, under which circumstances the pressure of the hand of an assistant above the pubes becomes of value, or the injection of a stream of water is advantageous. Occasionally, although rarely, the stone may be encysted. At times, when the stone is very small, it may be washed out with the first rush of urine, and consequently not felt. I have seen this happen in a child. At times a bladder may be opened and no stone found; "but from all my experience," writes Sir W. Fergusson, "I feel justified in stating my conviction that most of the cases heretofore related as instances where the incisions for lithotomy have been made, and a stone has not been present, have been examples where the Surgeon has failed to reach the bladder." In children this is particularly the case, the Surgeon pushing the bladder inwards off the staff. This accident is liable to occur when the neck of the bladder is not sufficiently opened.

Failure in reaching the bladder.

After the removal of the stone the finger or sound should be introduced into the bladder to ascertain the existence or non-existence of a second stone.

After-treatment.

As soon as the operation has been completed, the patient should be unbound and any bleeding vessels twisted. In children the introduction into the wound of a piece of ice, or the application to the wound of a cold sponge, with or without ice, is usually enough to arrest any hæmorrhage, and, in the adult, the same practice, as a rule, suffices. When, however, the hæmorrhage is persistent, a piece of sponge or a sponge tent should be introduced into the wound up to the neck of the bladder; such a proceeding arrests bleeding, though not the flow of urine, which percolates through the sponge. The sponge may be removed at the end of twenty-four hours.

Introduction of tube not necessary.

Liston was in the habit of introducing a gum-elastic tube, six inches long, through the wound into the bladder, to carry off the urine for the first two days, and fastening it in with tapes. This practice is still followed by some. It is, however, quite unnecessary; and at Guy's we use the tube only in exceptional cases—that is, when severe hæmorrhage ensues, the wound being plugged around it. Dupuytren employed a tube, to which was attached a circular piece of oil silk at its centre like an unribbed umbrella; sponge or charpie was introduced between the tube and silk when bleeding took place, after the upper end of the tube had been introduced through the wound into the bladder. Matthews has adapted an india-rubber bag around the tube, which can be introduced into the bladder empty, and then expanded with air and water. It answers the same purpose as Dupuytren's *canule à chemise*, and is, probably, more efficient.

Exceptions.

In exceptional cases, when the bulb is cut into, it may be necessary to apply pressure with the finger on the pudic artery to arrest bleeding.

Position after operation.

The patient having been placed in a bed, a good draw sheet should be placed beneath his hips and a pillow behind his knees to keep them flexed, while the knees *should not be tied together*. A sedative may be employed to give rest, but beyond this, little or no medical treatment is required. The diet should be nutritious but unstimulating, and wine and meat given as soon as the appetite demands. The bowels, if not acting naturally on the fifth or sixth day, should be cleared by an enema or mild aperient, such as castor oil, and the horizontal position should be maintained till the wound has closed. Key has remarked that in children partial incontinence is apt to follow when this rule has not been observed.

Difficulties during the operation. Care that staff is in bladder.

Sources of difficulty in Lithotomy, and how to avoid them.

The *difficulties* connected with the operation are too often due to carelessness and too great speed, consequently they are mostly of the Surgeon's own making.

If, however, he *feels the stone* and *hears its ring* before operating, he is sure of its presence, and knows also that the staff is in the bladder, and that it has not passed through any false passage in the urethra or between the bladder and rectum. If, moreover, *before* cutting he assures himself by touching the staff that it has not been displaced he has a direct guide down to the calculus.

Care that knife is in groove of staff.

If *when* cutting, after having exposed the groove of the staff, and then proceeding to the second step of the operation he feels the *two borders* of the *groove* with the nail of his left index-finger, and with certainty cuts between them *into* the groove, he will be still sure of his guide into the bladder, and not likely to fall into the not uncommon error of mistaking the side of the staff for the groove, and thus going astray.

Not to remove staff till fingers in bladder.

If, again, when running his knife down the director into the bladder, he pushes it sufficiently far as to feel all resistance cease, and for urine to flow, he may be certain that the bladder has been opened. And if, on introducing his finger into the bladder, "he never pushes the point of his forefinger onwards unless he feels certain that he has it between the staff and the wound," he is not likely to make a cavity with his finger in the cellular tissue outside the bladder, or to push the bladder off the end of the staff; and, if he never removes the director or staff till his finger or gorget has been introduced into the bladder as a guide to his forceps, he is still free from error.

Extract stone backwards and downwards.

In the last step, he has only to handle his forceps boldly to grasp the stone fully, and, in extracting it, *always to draw downwards and backwards*, with some rotation, and he will complete his operation without a mishap.

External wound free, and internal wound limited.

The external wound should always be free, the internal limited; moderate dilatation of the neck of the bladder being free from harm.

When surgeon loses his guide.

If in operating, the Surgeon lose his guide, from the end of the staff slipping out of the bladder, and he be unable to effect its reintroduction; or if by some error he has missed the staff, and allowed his knife to travel by its side, and thus failed to find the bladder, it is better to relinquish the operation, let the wound heal, and operate again, for without the guide of the director the operation is an impossibility, and all manipulation hazardous. But so long as the staff is in the bladder errors may be corrected, and the operation completed. For by the reintroduction of the knife along the groove, an opening into the neck of the bladder that has been made so small as to forbid the introduction of the finger may be enlarged, even when the neck of the bladder has been pushed backwards, and the finger seems about to travel into an unknown region.

When opening in bladder too small.

Wound of rectum.

Should the *rectum* receive a *small* wound during the operation it may be disregarded, as it is rarely followed by any injurious effect, and even when the wound is large it is well, perhaps, to leave the case to nature. Should it not heal, the case may have to be dealt with as one of fistula in ano, by division of the sphincter.

At times, the walls of the rectum, *after* the operation, may slough from the injury they sustained during the removal of the stone; but such cases usually do well when left alone. In my own practice this sloughing took place after the extraction of a large mulberry calculus, but the case did very well, nor was the recovery tedious.

When enlarged prostate.

Prostatic enlargement may be a cause of difficulty in the operation in elderly patients, and when with this enlargement there is rigidity the difficulties are increased, for the Surgeon, under these circumstances, in order to make a sufficient opening into the bladder, may have to travel far into the pelvis upon the staff, and when the bladder is opened he may be unable, on account of its depth, to reach it with his finger. Under these circumstances the blunt gorget becomes of great value, as it can readily be run along the straight or curved staff into the bladder, and form a certain guide to the introduction of the forceps. Martineau was very fond of the blunt gorget in most cases, and I am tempted to think that in adult subjects it might now be used more frequently with advantage. I have found the greatest benefit from its use in several cases.

Adenoid tumours.

When the prostatic enlargement encroaches on the bladder the vesical lobe may be lacerated by the blades of the forceps and torn away; and prostatic adenoid tumours may likewise be enucleated. Key noticed this in 1837; Fergusson brought the subject forward at the Pathological Society in 1848; Cadge exhibited two specimens in 1862; and in 1878 I reported two others. I removed one in the fork of my forceps, an inch in diameter, on January 19th, 1875, when operating for stone upon a man, æt. 67, with a mulberry calculus one inch and a half in diameter, and the man made an excellent recovery. The second was from a patient, æt. 70, who was operated upon in February, 1876; the prostatic tumour being enucleated during the extraction of a large stone with the forceps, and the recovery was complete.

Case.

When stone soft.

When the stone is *soft, friable,* and comes away piecemeal, it is wise to wash the bladder well out with a stream of tepid water; and, at times, when the stone is apparently held by the bladder in such a position as forbids its being caught by the forceps, a stream of water through the bladder may dislodge it, and allow of its removal.

In very large stones.

Very large stones should be crushed through the perineal wound before their removal, and a short strong lithotrite is the best instrument for that purpose.

In moderately large stones, when the wound in the neck of the bladder is not large enough, Liston's advice should be followed, and an incision made on the opposite side of the neck of the bladder by passing a blunt-pointed bistoury into the wound, guided by the finger, and turning its edge towards the *right* tuber ischii. Martineau says that he likewise often enlarged the inner wound two or three times, to facilitate the escape of the stone.

A second stone may form.

When a *second stone* forms in the bladder, and another operation is demanded, there is no reason why it should not be performed in the same position and manner as the first, and with equal success. I have, at intervals of three and fifteen months, had to cut a patient, æt. 60, three times for stone, removing on the first occasion seven calculi, on the second two, and on the third two, with good results. The stones averaged on each occasion more than an inch in diameter. The patient did as well after the second and third operations as after the first, and is now quite well. The Norwich statistics, as compiled by Mr. C. Williams, show that a third operation may be performed with like success ('Lancet,' May 18th, 1878).

Other Operations.

Median operation.

The *median operation* is the old Italian or Marian method, based upon the precept "a small incision, much dilatation," and has been revived by Allarton. It is performed as follows:—The operator first introduces an ordinary grooved staff into the bladder, and gives it to an assistant. He then passes his left forefinger into the rectum, with the palmar surface upwards as far as the *apex of the prostate*, and holds it there, as a guide to the next step of the operation. He then takes a long straight bistoury, and, with its edge upwards, introduces it about half an inch in front of the anus in the median line, down to the membranous portion of the urethra or apex of the prostate, into the groove of the staff, and presses it towards the bladder for about half an inch. He then cuts upwards, dividing the membranous portion of the urethra freely, and the soft parts of the perinæum, making an external wound about an inch and a half long. Through this wound he next introduces his finger into the bladder with a rotatory movement, the prostatic portion of the urethra and neck of the bladder being dilated, the forceps are then inserted into the bladder, and the stone removed.

Mode of performance.

Where the stone is large, Allarton employs Weiss's three-bladed female dilator, or Arnott's hydraulic dilator.

Remarks on the value of the median operation.

This operation as described is precisely the one now generally performed for the digital exploration of the bladder and the removal of growths from the bladder. It is found to give abundance of room for these purposes, and may therefore be said to be of value for the removal of foreign bodies or stones of moderate size from the bladder. I have employed it in several cases of stone during the last three years with success, and in one case removed five calculi over half an inch in diameter with facility. I am indeed disposed to think that this operation may prove to be better than the lateral in old subjects, for it is certainly attended with less hæmorrhage. In children, the dilating process is dangerous, and apt to be attended by a tearing away of the neck of the bladder from its perineal attachment. The experience of Norwich Surgeons, however, in no way tends to give it any support, the mortality of the median being nearly twice as great as that after the lateral operation.

Dolbeau's operation.

Dolbeau's operation must be mentioned as a modification of the median. A full description of it can be found in his work on 'La Lithotritie Périnéale,' 1872. In its first step where the membranous portion of the urethra is opened, it differs in no important respect from Allarton's, but in the second, the neck of the bladder and parts external to it are dilated, while in the third, unless the stone be very small, it is broken before removal.

The dilating process, an essential part of the operation, is effected by means of a very ingenious six-bladed dilator, the blades of which are so arranged as to separate without diverging, by means of two balls which move upon a central stem.

The external parts down to the urethra are dilated first, then the membranous portion of the urethra, and lastly, the neck of the bladder; the passage into the bladder by these successive dilatations being of uniform calibre and with smooth walls. The stone is broken, not crushed, by the "cassepièrre," an instrument that opens in the bladder without divergence of its limbs. The fragments should then be removed with care and the bladder washed out.

Dolbeau claims for this operation great advantages, which are not yet proved. The instruments, however, are very ingenious.

Bilateral section of the prostate.

Dupuytren's bilateral section of the prostate for the removal of large stones, with the semilunar transverse perineal incision in front of the anus, meets with few supporters at the present day. He made his first incision with a scalpel down to the membranous portion of the urethra, and afterwards introduced into the groove of the staff a double-bladed curved lithotome which was pushed, closed, down to the stone into the bladder along the staff. The blades were then opened transversely, and the instrument withdrawn. By these means the neck of the bladder and prostate were freely incised, the prostatic section having an oblique direction downwards.

Civiale's operation.

Civiale in 1836, suggested his medio-bilateral operation, "being dissatisfied with the bilateral, and shunning the lateral method on account of the anatomical objections." Having introduced a staff with a median groove, he made an incision in the median line an inch and a half long in front of the anus down to the membranous portion of the urethra. He made also a free opening into the urethra, and then introduced an instrument similar to Dupuytren's lithotome, but straight, along the groove of the staff into the bladder, opening the blades when the bladder had been entered, and dividing the neck of the bladder on its withdrawal. The finger was then introduced, staff removed, and forceps inserted, the stone being removed as in other operations. It differs little from Dupuytren's, except in the form of perineal incision. Sir H. Thompson, who first described this operation in England, as well as Erichsen, have both successfully removed calculi by this operation.

Buchanan's operation.

Dr. Andrew Buchanan's operation with the rectangular staff, bent three inches from the point, and deeply grooved laterally with a posterior opening, is essentially a central operation. He suggested it in 1847.

Mode of performance.

The staff is introduced into the bladder, and guided by the finger in the rectum, the angle of the staff is made to correspond to the apex of the prostate. The operator, still retaining his finger in the rectum, inserts a long straight bistoury in front of the anus, with the blade horizontal and edge turning to the left down to the groove and angle of the staff, and pushing it towards the bladder to stop at the end of the staff. He then withdraws the knife, and as he does so, makes a curved incision through the soft parts around the left side of the rectum towards the tuber ischii, the wound being about an inch and a half long. Dr. Buchanan describes his operation as being half that of Dupuytren's. When the stone is large, the right side of the prostate is cut, thus approaching it more nearly as a whole.

Recto-vesical operation.

The recto-vesical operation was at one time a very favourite one.

The late Mr. Lloyd, of St. Bartholomew's, was about the last English Surgeon who freely practised it, whereas now it has been almost lost sight of. The operation consists in the introduction of the knife into the rectum, with the blade flat upon the palmar surface of the right index-finger, the turning of the edge of the knife upwards, and the perforation of the bowel and urethra at the apex of the prostate down to the groove of the staff; the sphincter and soft parts being freely divided upwards in the median line of the perinæum for about one inch on the withdrawal of the knife. The left forefinger is next inserted into the wound down to the groove of the staff, and the bistoury again introduced with its edge downwards and pushed into the bladder along the groove, the neck of the bladder and prostate being freely divided when the stone is large. The finger is then passed into the bladder along the staff, the staff removed and forceps passed, the calculus being extracted in the usual way. As an ordinary operation, this is greatly inferior to the lateral. König's statistics, as quoted by Poland, show it to be very unsuccessful. When the stone is very large, it may, however, be entertained.

Supra-pubic operation.

The high operation or supra-pubic, is one of the oldest, and was practised by Cheselden and Civiale. It was at one time supposed to be the most direct and least dangerous operation, the only dangerous part involved in it being the peritoneum, which can readily be avoided. For large stones it may be entertained.

The operation consists of three stages:

Mode of performance.

The *first* consists in exposing the anterior wall of the bladder by a vertical incision made in the median line above the pubes through the parietes, with the patient on his back, his pelvis raised and bladder moderately distended with a 1-per cent. solution of carbolic acid or thymol of the temperature of the body, and well raised out of the pelvis by the rubber rectal dilator (Fig. 325).

The *second* step is that of opening the bladder, and care should be observed that this opening is made in the median line and *close to the symphysis*. This is best done by transfixing the bladder where it is exposed, and opening it from below upwards, care being also observed that the wound in the abdominal parietes is carefully kept open with retractors.

The *third* step is the removal of the stone by means of forceps.

After the operation, the wound in the bladder should be brought together carefully with sutures, and the external wound closed above, a space being left below for drainage, and the case left to nature. The urine should subsequently be drawn off at short intervals.

The statistics of the operation are not quite satisfactory. Gross gives one death in four cases; Civiale, one in two; Humphry, of Cambridge, and Dulles, one in three. The latter author speaks highly of it ('American Journal of Med. Science,' July, 1875; April, 1878). He believes the operation to be deserving of more attention, and should receive a fairer trial than it has yet had.

All these varieties of operations have been detailed, as exceptional cases of stone may be met with in which one or the other may be better than the lateral, but as a general operation, lateral and median lithotomy are the best, and of the modes of performing the lateral operation, Key's is the simplest and most successful.

Causes of Death after Lithotomy.

Causes of death after lithotomy.

When patients die unrelieved with calculus, they generally do so from kidney disease, and in the majority of fatal cases of lithotomy, the same cause produces a like result. When kidney disease is *not* present any of the operations described for the removal of the stone, when performed with average skill, is likely to be successful. When kidney disease exists, any operation is likely to prove unsuccessful.

These facts are fully illustrated in a paper I read in 1862 (Roy. Med. and Chir. Society) on the causes of death after lithotomy.

Prognosis.

The longer a stone remains in the bladder the greater are the probabilities of renal disease, and, consequently, the larger the stone the greater the risk.

The duration of the symptoms and the size of the stone are consequently valuable aids in forming a prognosis.

When death takes place from so-called shock, it is probably connected with organic renal disease.

Hæmorrhage.

In a small proportion of cases, death takes place from hæmorrhage; such a result, however, when uncomplicated, being very exceptional. It does not probably occur once in a hundred cases.

Pelvic cellulitis and peritonitis.

Pelvic cellulitis and peritonitis have usually been regarded as common causes of death. Pelvic cellulitis is very insidious, and often only positively made known when some peritoneal complications make their appearance. Its cause has generally been assigned to a too extensive incision of the neck of the bladder, but the careful investigation of a large number of fatal cases suggests the probability, that although a fatal complication, it is one which for the most part arises without urinary infiltration and as a result of continuity with structures that have become inflamed from injury sustained during the operation, or, from the prolonged presence of the stone. It is also commonly associated with renal disease, and it is now well known, that under such circumstances, the inflammation of serous membranes is very common. It is consequently an open question as to how far the renal disease or the operation is the cause of the pelvic cellulitis and peritonitis.

Acute cystitis.

Death from acute cystitis may occur, as it may from the hæmorrhagic diathesis, pyæmia, chloroform, or any accident.

Uræmia.

Uræmia, as a cause of death, is classed with renal disease.

In children, incontinence of urine is apt to follow the operation particularly when the horizontal position has not been rigidly enforced during the healing process. It is, however, a rare effect.

Wasting of a testis may likewise take place from some disease or wound of the vas deferens. I have, however, known this to occur but once. Cases of it have, however, been recorded by Teevan and others.

STONE IN THE FEMALE BLADDER.

Calculus in the female bladder.

Calculi are doubtless formed as frequent in the kidney of the female as in that of the male, and pass downwards into the bladder, although from the absence of the prostate as well as owing to the shortness and dilatability of the female urethra, they rarely require surgical treatment.

The records of surgery contain many instances in which large calculi have been passed by natural efforts from the female bladder without any very injurious effect resulting, and Mr. Clogg, of Looe, Cornwall, has recorded a case, in which a stone nearly four inches round was thus passed ('Brit. Med. Jour.,' May 2nd, 1874). But the experience of every Surgeon will supply him with instances in which calculi of moderate dimensions have been readily passed, and I have a specimen of mulberry stone, nearly an inch in diameter, which a young woman thus got rid of.

In neglected cases of vesical calculi in women the stone may, however, excite ulceration of the bladder, or be discharged per vaginam.

Symptoms.

The *symptoms* of stone in the bladder of the female are very similar to those in the male, such as irritability of bladder, pain during and after the act of micturition, intermittent flow of urine, and hæmaturia, a bearing-down pain and incontinence of urine being common accompaniments. In the female sex, uterine and vesical symptoms are so closely associated, that Surgeons cannot be too much aware of the fact, since cases of stone in the bladder are frequently passed over as examples of uterine disease, when a vaginal examination would reveal the true state of affairs; a calculus can often be felt by the finger through the vesico-vaginal septum, but where doubt exists, the sound will settle the point.

Treatment.

The *Treatment* of stone in women is far less complicated than in men, on account of the anatomical formation of the parts, and the majority of calculi can be readily removed either by urethral dilatation and extraction or by lithotrity.

By urethral dilatation.

The method by *urethral dilatation* is based on the natural one of expulsion, and is applicable in all cases of small calculi. In children, a stone three quarters of an inch in diameter, and in adults of one inch in diameter, with the patient under the influence of an anæsthetic, may be fearlessly removed from the bladder by rapid urethral dilatation and extraction. Indeed, I have removed calculi two inches in diameter by this means, without any injurious after-effect; but it is probably wise not to make the attempt, the Surgeon possessing in lithotrity an efficient aid or substitute.

Rapid dilatation preferred. Mode of performance.

Slow dilatation of the urethra is almost certain to be followed by incontinence, while after rapid proceedings, it is rare to meet with this result.

The operation may be performed as follows:—With the patient on her back under the influence of an anæsthetic, the urethra should be dilated by my urethral dilator, Fig. 394, sufficiently far to allow of the introduction of the left index-finger, or by Weiss's three-pronged dilator which should be introduced and rapidly expanded. The forceps should then be introduced, when the stone, having been seized, can be rapidly removed. I have on several occasions employed the lithotrite for this purpose with the view of crushing the stone should any difficulties be experienced in its extraction, and therefore recommend the practice. On four occasions I have not dilated the urethra at all, but passed the lithotrite or forceps and extracted at once, and consider this plan is as good as any other; for every Surgeon must be struck with the facility with which a finger or any moderate instrument can be introduced into the female bladder when the subject is under the influence of an anæsthetic.

If any difficulty is felt in the extraction of the stone, or it prove larger than can be safely removed as a whole, it may be broken up and removed piecemeal. By these means I took away at one operation without any difficulty or bad result from a child only four years old, a calculus an inch and a half in diameter, and in the year 1869, I successfully removed with facility three calculi from three patients by these means. In female subjects there can be no such hesitation as to the wisdom of removing fragments after the crushing operation as there is in males.

When stone very large.

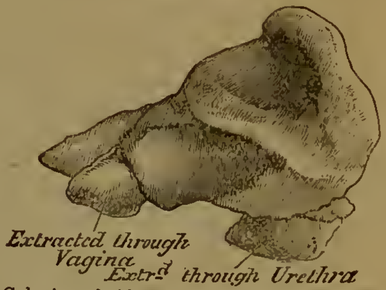
Removal per vaginam.

When the stone is too large for removal by rapid dilatation, or the bladder too contracted, inflamed, and ulcerated to allow of lithotrity, the stone should be removed per vaginam, the Surgeon in this operation again imitating a method sometimes resorted to by nature. To do this, a clean incision of sufficient length to admit the removal of the calculus has to be made into the bladder through the vaginal septum, guided by a director introduced through the urethra. The wound should subsequently be closed by means of stitches, as in vesico-vaginal fistula.

Example.

I have removed, in this way, a stone two inches long, that formed a complete cast of the contracted bladder with good success. (Fig. 354.) Dr. Aveling and M. Vidal strongly recommend this operation, while the late Marion Sims thought so well of it as to assert, "that it is the only justifiable operation for stone in the female bladder," and if by the word operation he means a cutting one he is certainly right, for where the urethra has been divided to allow of the removal of stone, incontinence is a common consequence.

FIG. 354.



Calculus, half natural size, removed from the female bladder through the vagina.

Urethral lithotomy is here mentioned only to be condemned, as any incision into the neck of the female bladder is liable, as has just been said, to be followed by incontinence of urine; half of the cases, as a rule, being so affected.

Summary of treatment.

By way of summary, therefore, it may be concluded:

That a stone of moderate size may readily be removed from the female bladder by immediate extraction, and one of larger dimensions by lithotrity and extraction, the patient being *fully* under the influence of an anæsthetic. That where from the size of the stone, immediate extraction is not advisable, or, from the condition of the bladder lithotrity cannot be performed, vaginal lithotomy is the best operation, while all slow dilatation of the urethra is to be avoided, and all urethral lithotomy condemned on account of the frequency of incontinence of urine as the result of such treatment.

For further information and statistics, *vide* Dr. Aveling, 'Obst. Trans.,' 1864; and paper by author, 'Med.-Chir. Trans.,' 1864.

Foreign Bodies in the Bladder.

Foreign bodies in bladder in male and female.

These are occasionally met with both in the male and female subject. Broken catheters and bougies are probably the most common; but a tobacco pipe, pins, French chalk, slate-pencil, straw, a silver toothpick, penholder, &c., are in the Guy's Museum recorded as foreign bodies that have been removed from the male bladder, and a bone bodkin-case, a cedar-pencil, and a stiletto from the female.

Example.

Foreign bodies may, however, obtain access to the bladder through wounds, gunshot or otherwise, or through abscesses connected with bone. Brodie has related a case in which he removed a calculus from a young lady which contained "a small portion of bone, and two imperfectly formed human teeth," doubtless the remains of a blighted ovum or contents of some dermoid cyst; and a second, in which a stone from the female bladder had a hazel nut as a nucleus.

When a foreign body remains long in the bladder, it acts as an irritant, and usually becomes rapidly covered with phosphates (Fig. 341). In a specimen at the College of Surgeons a foreign body is the nucleus of a uric acid calculus.

Mode of removal in male.

When in urethra.

As soon as a foreign body is known to exist it ought to be removed. Where this can be effected through the urethra so much the better; and as long as the substance is in the passage and not impacted, this may be done; but when this cannot be effected and the urethra is the seat of the offending body, a clean incision should be made and the foreign body removed, as incised wounds into the urethra usually heal well, and it is better to make them than to lacerate the urethra by forcible internal manipulation.

I had a case some years ago in which a long hairpin had been impacted in the penis and perinæum with its points forwards, one end being felt at the base of the penis embedded in the tissues beneath the skin. Under chloroform, I pressed the point through the skin and gradually withdrew the pin, which came out nearly straight. A rapid recovery followed, without a bad symptom.

When in bladder.

When the foreign body is in the bladder and cannot be crushed by the lithotrite or drawn out by the scoop, cystotomy must be performed, and in adults, when the foreign body is not large, the median operation should be chosen.

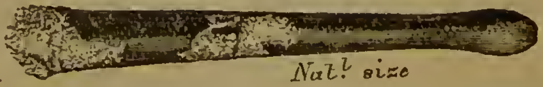
The portion of catheter illustrated below (Fig. 355) I removed from the bladder of Mr. B—, æt. 61, on August 23, 1875, by means of a small lithotrite, thirteen days after it had been broken off in the bladder.

I was fortunate enough to catch it at its bulbous end and to withdraw it without much difficulty, a rapid recovery following.

Mode of removal in female.

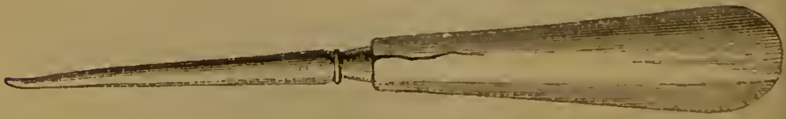
In *women* under the influence of an anæsthetic the body may usually be readily extracted by means of dressing or other forceps. In the case in which a lady's stiletto (Fig. 356) was in the bladder of a young

FIG. 355.



End of catheter removed from male bladder with lithotrite.

FIG. 356.



Stiletto removed from female bladder.

woman I found the point of the instrument presenting forwards and upwards and fixed in the symphysis. With my left finger in the urethra I pressed it back, and, after some little manipulation with the right index-finger through the rectum, for the patient was a virgin, I so placed the stiletto as to fix the point against the pulp of my left index finger, and with a pair of forceps introduced upon my finger extracted it. The patient recovered without any inconvenience.

Most cases may indeed be treated with a pair of forceps in the bladder and a finger in the vagina or rectum to manipulate and place the foreign body in a good position for removal; the Surgeon seizing the foreign body by one end. For the removal of such a thing as a hair-pin, a blunt hook may possibly be serviceable.

CHAPTER XXIII.

SURGERY OF THE URETHRA.

Definition.

A DIMINUTION in the calibre of the urethra, the result of organic changes within its walls, gives rise to "*stricture;*" any encroachment on the passage from without or within causes "*obstruction.*"

Obstruction and its causes.

Obstruction occurs when the urethra is narrowed from inflammatory engorgement of its mucous and submucous tissue (the inflammatory stricture of some authors), or from spasm of the urethral muscles (spasmodic stricture); when an abscess or tumour outside or any prostatic enlargement encroaches on the urethra, or when any fracture of the pelvis presses upon it; and lastly, when a calculus or foreign body is impacted in the passage, or a urethral polypus blocks it up.

Organic stricture, and its causes.

Organic stricture is caused by the contraction of inflammatory deposit situated upon, within, or beneath the mucous membrane of the canal, or from the contraction of the cicatrix of a ruptured or injured urethra. The first form may be described as "*simple organic stricture.*" The second as "*traumatic or cicatricial stricture.*" The former is the more common, my notes showing 603 examples of the former to 43 of the latter in consecutive cases, or in the proportion of fourteen to one.

Generally chronic.

In the majority of cases the contraction of an organic stricture is of a chronic nature, and in some may be readily traced to a more or less distinct chronic inflammation of the passage; but years will frequently pass before the obstruction to the flow of urine becomes of sufficient importance to arrest attention, and a sudden attack of retention of urine, induced by some act of irregularity or exposure to cold, will probably be the first symptom to draw the patient's attention to his condition.

Varieties of stricture.

The stricture may consist simply of a perforated membranous diaphragm stretched across the canal; of a narrow band of inflammatory product surrounding the passage, to which the terms "whip-cord," "ring," or "annular" stricture is attached; and in rarer cases to bands of lymph stretching across the passage, and forming what are known as "bridle strictures." It may be general or partial, and when the latter, may have been caused either by some adhesion of the natural rugæ of the urethra, or of some folds of its mucous lining.

When the stricture is more extensive, there is hardly a limit to the extent of inflammatory deposit which may exist from the narrow band already alluded to as forming the "annular" stricture, passing onwards to the broader band which answers to Sir A. Cooper's term of "ribbon" stricture, to the still severer cases in which the urethra is found more or less contracted throughout its entire course. Between these extremes, numberless varieties and degrees of mischief may be observed, the urethra presenting one single contraction, or several independent ones. John Hunter mentioned a case in which six strictures coexisted.

Impermeable stricture.

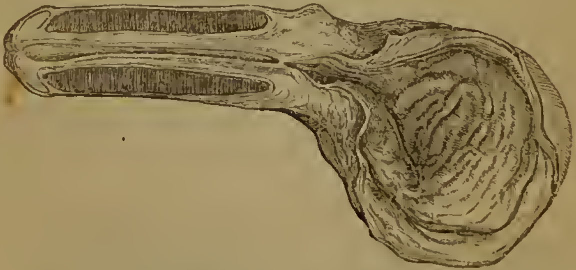
Lastly, the urethra may unquestionably become "impermeable," the pathological specimens in Guy's Museum being sufficient to demonstrate the fact. Such a condition, however, cannot exist uncomplicated with other symptoms, since it is obvious that the urine must have some channel for escape. In these cases, therefore, urinary fistula will always be found. An *obliteration* of the urethra, the result of injury from cicatricial stricture, is also met with.

Locality of stricture.

Locality of Stricture.

For the only definite facts relating to this subject I must refer, and I do so with pleasure, to the labours of Sir H. Thompson; for although other writers have given their "impressions" upon the subject, and published isolated cases, it is to him that the profession is indebted for the analysis of 270 preparations contained in the various museums, by which inquiry alone this question could have been satisfactorily determined. He has most satisfactorily proved what is now generally received as true, that in by far the majority of cases of stricture the juncture of the spongy and membranous portions of the urethra is its most frequent seat (Fig. 357), and that the inch situated in front of this spot is the next position in point of frequency, while exceptional cases may be found in the prostatic end of the membranous portion, at the external orifice, or at the terminal two inches of the urethra, but no specimen existed in which a stricture has been observed in the prostatic portion.

FIG. 357.



Stricture of the urethra, with dilatation of urethra behind stricture and hypertrophy of bladder.

Statistics of causes.

Looking over my own cases with a view to inquiring into the *causes of stricture*, I find, omitting congenital narrowing of the urethra, that chronic gonorrhœal inflammation had existed in 273 out of the 646 instances, and that in 78 of these, injections had been employed in its cure; that direct injury was the assigned cause of 43; while in 330 no definite cause could be obtained. With these facts it seems, therefore, right to conclude "That although gonorrhœa often precedes a stricture, at least half the cases are found in subjects who have not suffered from such a disease; and that when gonorrhœa might be assigned as a cause, the use of injections for its cure does not appear to have had any positively injurious influence in producing a stricture." I may add that these results can be strictly relied on, as, when noting the cases, considerable care was taken to search out this fact. It may therefore unquestionably be asserted that injections have not the injurious influence in exciting stricture which some authors have ascribed to them.

Gonorrhœa as a cause.

Injections as a cause.

Among the 330 cases in which no positive cause could be assigned, were three in which "gout" existed; and several in which the contraction of chancres might fairly be ascribed as the cause of the obstruction.

I have been unable to discover that the so-called phosphatic diathesis has any influence in exciting the formation of an organic stricture, or any other urethral disease, although this is a point upon which Sir B. Brodie has largely dwelt; but there can be no doubt, that any morbid condition of the urine has considerable power in exciting a spasmodic contraction of the muscular walls of the urethra, more particularly when an organic stricture exists, and of inducing retention of the urine.

Phosphatic diathesis as a cause.

Symptoms.—In a large proportion of the cases of simple organic stricture an attack of retention of urine is the first thing which attracts the attention of the patient, which may have followed some indiscretion in diet, excess of drinking, or exposure to cold. It is then, perhaps, for the first time, that the patient can bring to his recollection the fact that other less marked, but not less certain symptoms, had existed previously for some time. It may be that a *chronic gleet* had been present for many months, or that some urethral pain or difficulty had attended the act of micturition, that the stream of urine had been somewhat narrowed, divided, twisted, or of a screw shape; or that micturition had been more frequent or prolonged; yet these symptoms by themselves had failed to make sufficient impression upon the mind of the sufferer as to lead him to suspect the existence of a stricture.

Symptoms of stricture.
Retention.

Altered stream.

It must not be thought, however, that the retention is usually caused by the gradual contraction of the stricture, though in exceptional cases such a condition may exist, yet it is tolerably certain that in the majority, the retention is due to some spasmodic action of the urethral muscles at the seat of stricture, for very slight causes appear capable of exciting spasmodic action of the canal in a diseased urethra, and consequently of giving rise to retention; spasmodic and organic stricture being generally combined. Indeed, out of 483 cases of stricture consecutively admitted into Guy's, 129, or more than *a fourth*, were suffering from retention. When the stricture is not discovered under these circumstances it will, if not detected early, soon give rise to other and more characteristic symptoms. The stream of urine will gradually contract, so that it will at last cease to exist, the urine passing only in drops. The bladder will become so irritable that the patient will have to rise frequently in the night to micturate, and the effort will be attended with pain; a small quantity of urine,

Retention may be due to spasm of muscles.

Frequency of retention in organic stricture.

Irritable bladder.

Rectum affected.

moreover, will probably also be passed; symptoms affecting the rectum will soon appear, and the straining during the act of micturition will be associated with tenesmus; these symptoms at times being so severe as to necessitate, whenever natural relief is sought, the use of the stool instead of the chamber vessel. Prolapsus recti, or piles, also frequently complicate the case, while incontinence of urine may follow.

Urine altered.

Gross's incontinence of retention.

Under these circumstances it is clear that the bladder is never emptied, although some small quantity of urine may be passed at each act of micturition. The retained urine, undergoing partial decomposition, acts as an irritant, and becomes cloudy and ammoniacal, depositing more or less mucus and phosphates. The urine collecting, gives rise to distension of the bladder, which, pressing on the rectum, excites tenesmus and prolapsus, and, interfering with the return of the venous blood, to piles. As the distension increases the bladder loses its power of contraction, and consequently expands till it overflows—the *overflow* of urine giving rise to *incontinence* which is a direct result of chronic retention. A physical examination of the abdomen of a patient under these circumstances will reveal the distended viscus as a central globular swelling, giving a dull sound on percussion.

Changes behind stricture.

Abscess.

Fistula.

During these changes, others no less important are going on at the seat of stricture; the urethra behind the stricture dilates—this dilatation being mechanical and the direct result of the ineffectual efforts of the bladder to overcome the obstruction (Fig. 357). As the pressure continues, inflammation of the urethra and parts around appears, the tissues as they expand become indurated, and after a time, ulcerate. A few drops of urine, as a result, then percolate into the cellular tissue behind the stricture, and, setting up suppuration, form a urinary abscess, which to the finger will appear as a deep-seated perineal swelling. When the abscess is slow in its formation, it will be indolent and painless, but if rapid, very painful; when opened or left to natural processes it will almost to a certainty be followed by a *perineal urinary fistula*.

Extravasation.

If, however, the abscess and the urethral stricture be left unrelieved, and the bladder with the abdominal muscles still continue to act ineffectually to overcome the urethral obstruction, the urine by being forced into the dilated urethra behind the stricture and into the perineal abscess communicating with it, will sooner or later cause rupture of the abscess into the cellular tissue of the parts around, and as a result give rise to extravasation of urine.

When the parts thus give way during the efforts of the patient to overcome the stricture, or some uncontrollable spasmodic action of the bladder and abdominal muscles, a sudden relief from the previous agony and a sensation that something has yielded may for a time lull the apprehensions of the patient and mislead him into the idea that all is well; but the swelling of the perinæum, scrotum, penis, and supra-pubic region, which must soon follow, with the absence of any flow of urine through the natural channel, will reveal to the professional eye the true nature of the accident, and prove that the urethra has given way behind the stricture, and that *extravasation* of urine has taken place.

Instruments for the Detection of a Stricture.

Catheters employed for stricture.

For the detection of a stricture as well as for its dilatation, *metallic* catheters, *elastic* catheters or *filiform* bougies may be employed.

The metallic catheter I prefer is that figured 342-3. The curve being short, the end bulbous and a size larger than the shank, this form of catheters is very perfect for mere examination purposes. The elastic instruments are upon the French model and are made of the same material throughout, a groove in the top answering as a substitute for the ivory head which is never known to keep its place, and when a catheter has to be fastened into the bladder, the benefit of this arrangement is at once proved. These catheters are made very small (Fig. 358), even to the half size. For dilating a stricture they should always be preferred.

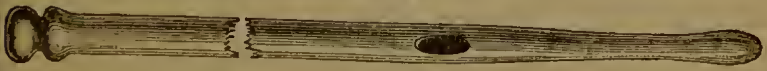
Unfortunately the sizes of the French and English catheters are not alike, the former being much more gradual in their increase. I append a table of the two scales:

No. 1	English	=	No. 7	French.	No. 10	English	=	No. 19	French.
„ 2	„	=	„ 8	„	„ 11	„	=	„ 20	„
„ 3	„	=	„ 9	„	„ 12	„	=	„ 22	„
„ 4	„	=	„ 11	„	„ 13	„	=	„ 23	„
„ 5	„	=	„ 12	„	„ 14	„	=	„ 25	„
„ 6	„	=	„ 15	„	„ 15	„	=	„ 26	„
„ 7	„	=	„ 16	„	„ 16	„	=	„ 27	„
„ 8	„	=	„ 17	„	„ 17	„	=	„ 28	„
„ 9	„	=	„ 18	„	„ 18	„	=	„ 30	„

The filiform bougies are made of the same material as the elastic catheter or of catgut or whalebone. I prefer the first and last, as they are made very fine and smooth, with or without olive tips; some are of the same thickness throughout, whilst others have finer points than shafts. They can often be insinuated through a narrow stricture when a catheter cannot be introduced, and are consequently of great value for dilating purposes.

As guides into the bladder they are also of equal use, and particularly for internal or external urethrotomy. When these small bougies are used the urethra should be previously filled with oil.

Fig. 358.



General symptoms.

During the development of a stricture, and more particularly when the stricture has become a real cause of obstruction, a patient's general condition is rarely good, and what are generally known as dyspeptic symptoms commonly exist; as a consequence, from the digestive organs failing to do their duty as in health, the patient often loses flesh, looks careworn and ill. As the disease progresses, a constant feeling of chilliness is very common, and rigors, followed by fever, are not unusual; these symptoms are at times intermittent, and are often regarded as being due to "ague." When a perineal abscess is forming, they are commonly present.

Rigors.

When the rigors are uncomplicated with abscess and are still frequent, there is good reason to believe that they indicate some renal complication; for it cannot be too strongly impressed upon the Surgeon's mind, that no stricture can long exist without producing secondarily important changes in the bladder and kidneys.

Results of Stricture.

Analysis of 100 fatal cases of stricture. 'Guy's Rep.,' vol. xix, series iii.

When a stricture is neglected, renal disease is certain to follow, and when death takes place as a consequence of stricture, it will be from kidney disease if it has not been suddenly brought about by one of the complications of stricture, such as retention or extravasation of urine. Thus, out of 100 deaths from stricture analysed by Dr. Goodhart the kidneys were suppurating in 41; wasted or inflamed in 18; diseased in a less degree or cystic in 7; and healthy in 34, or about one third.

Varieties of organic stricture.

Organic strictures are not, however, all of the same character.

The simple stricture is the most usual, and beyond the mechanical effects of its existence has no special feature. **The irritable stricture** is comparatively rare, and is characterised by excessive sensibility on being touched by a catheter, with a disposition to bleed. It is also prone to be associated with chilliness and even rigors. **The contractile stricture** may belong to either of the two former groups; its peculiarity consisting in its tendency to *recontract after its dilatation.* The **cicatricial or traumatic stricture** has characters of its own, and of these, its obstinacy is the most marked.

It is important to bear these divisions of organic stricture constantly in mind, for the successful treatment of a case will often turn upon their recognition.

Examination for stricture.

On making a urethral examination.—Before a Surgeon can say with certainty that a stricture exists, a urethral examination is often a necessity, and this is an operation in which difficulties are met with by the inexperienced; indeed, without some skill and confidence, the attempt to pass a full-sized catheter down even a healthy urethra constantly fails.

Mode of passing catheter.

To pass a catheter it is usually wise to place the patient in the recumbent position, with the shoulders slightly raised and the knees separated; he should, too, be lying quite straight, with the abdomen exposed to the navel, as the linea alba is the best guide as to the line of the urethra. A large metallic instrument (No. 7 or 8 being the best) should be selected for the examination, and made moderately warm by being dipped in warm water or rubbed by the hand, and thoroughly well oiled. The operator should stand on the *left* side of the patient, and, raising the penis with his left hand, should introduce the end of the catheter into its urethral orifice, keeping its point during the introduction of the first three or four inches well to the *lower* surface of the urethra, in order to avoid the lacunæ that exist in the roof of the passage. The handle of the instrument at this step of the operation may be directed over the left thigh of the patient, or, what is preferable, maintained over the median line of the body in the direction of the umbilicus. With the left hand he may then gently draw the penis up the instrument, while he allows the catheter by its own weight to slip down the passage, simply directing it with a light hand. When its end has reached the bulbous portion of the urethra the handle of the catheter must then be gently depressed in the central line of the body, and, if no obstruction exists, the bladder will be entered; the point of the instrument during this movement being kept well along the *upper* surface of the urethra. In a healthy urethra, indeed, the Surgeon has little more than to *guide* a metallic instrument into the bladder, the weight of the catheter being alone nearly sufficient to allow

Position of Surgeon.

Manipulation where no stricture.

it to pass down the passage. Half the errors committed in catheterism arise from a non-appreciation of this fact; the desire to *pass* the catheter originating efforts that interfere with the entry of the instrument into the bladder under proper guidance.

Where stricture exists.

When a stricture exists the catheter will be arrested in its course; and, under these circumstances, it should be withdrawn an inch or so and passed on again, with the handle slightly altered in direction. If the resistance is still felt the instrument should be withdrawn, and one of a smaller size employed, and on this failing to glide by the obstruction a yet smaller one should be tried, and so on till the stricture is entered.

Avoid force.

The seat of stricture or strictures, as well as the nature of the contraction, will be made out by this process. If much pain attend the examination the Surgeon has employed either too much force or an irritable stricture exists; and if bleeding follows, this latter probability is strengthened, particularly if no violence has been employed. Catheterism, indeed, ought never to be attended with violence, and if gentle measures do not succeed, no other should be attempted.

Catheterism in erect position.

In passing a catheter, some prefer the patient to be in the erect position, but I cannot recommend it; there is more chance of inflicting injury in this position by the patient moving, and the Surgeon has not so complete a control over his instrument or patient as when he is recumbent. When there is a stricture the erect position is certainly wrong. The mode known as the "tour de maitre" has only to be named to be condemned; though in the hands of a skilled Surgeon it may be done with impunity. The plan consists in introducing the catheter—the patient standing—with the handle presenting downwards, and the convexity of its curve upwards, passing it along the urethra down to the bulb, and then, onwards into the bladder, by describing a half circle towards the umbilicus, the handle of the instrument, when it has reached the median line of the body above, being gradually depressed, and the end of the instrument in this turn made to enter the bladder.

Treatment of Stricture.

The treatment of stricture must be based on the pathology of the disease; and mild means should always be preferred to forcible or cutting measures.

Pathology of stricture.

The pathology of stricture is simple, and consists either in the deposition of inflammatory products in the mucous and submucous tissue with their subsequent contraction, or in the contraction of a cicatrix, the result of an injury.

Principles of treatment.

The principle of treatment is also simple, for it is, *primarily*, to dilate the contracted canal, and *secondarily*, to obtain the absorption or breaking up of the effused inflammatory products. The more simple the means by which these ends can be secured the better.

Where the first end has been obtained without the second, temporary benefit may have been effected, but no more. Where both ends can be gained by simple means the treatment must be pronounced good. In ordinary cases of organic stricture there is little doubt that these ends are to be secured by *dilatation* of the stricture; and that by such local treatment alone the majority of cases of organic stricture may be successfully overcome.

Continuous or intermittent dilatation.

Now, this treatment by dilatation may be *continuous* or *intermittent*.

The former method is to be preferred, and should be carried out as follows; it is the most rapid and effectual the Surgeon has at his disposal, although it necessitates about a fortnight's rest.

Mode of carrying out continuous.

The continuous method.—The size of the stricture having been gauged, an elastic conical catheter with a bulbous end is to be taken and well oiled, and as large a one as can be passed through the stricture introduced. Should the English catheter be preferred it ought to be made soft and flexible by being dipped in warm water or by friction with the finger, and used without the stylet. The penis of the recumbent patient must then be raised by the left hand, and drawn forward as well as slightly downward, so as to make the urethra as straight as possible. The catheter should then be introduced, and passed gently down the passage. If obstruction be felt, the catheter may be slightly withdrawn, and then pressed forwards. The largest instrument the stricture will admit without force should be introduced, and having passed the stricture and entered the bladder, it is to be fastened in (Fig. 359). The end of the catheter up to its eye alone should rest in the bladder.

The orifice of the catheter may either be plugged with a peg of wood, or the end capped by a piece of india-rubber tubing, the free end of which should be dropped into a urinal, or tied in a knot to prevent escape of urine.

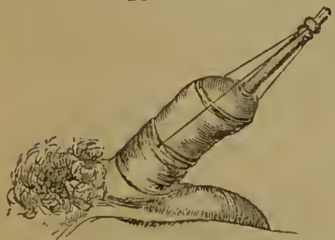
When to replace catheter.

When causing irritable bladder.

Where rest cannot be given.

After twenty-four hours if the catheter moves freely in the stricture it may be removed and a larger size introduced, the Surgeon being careful not to be tempted to introduce one that fits the stricture too firmly. On the third and following days, the same practice may be followed, and in about ten days a complete dilatation of the stricture will probably have been perfected. If the catheter does not move freely in the stricture, it must be left a few hours longer. When the presence of the instrument in the bladder causes irritation, which is not remedied by such alkalies as the citrate or tartrate of potash with buchu and hyoscyamus, it is wise to have the catheter removed some few hours before a larger size is introduced; thereby giving the bladder rest. When it is impossible for the patient to maintain rest, a catheter may be passed in the evening, retained all night, and removed in the morning. At other times where the symptoms are more severe, some slight intermission of the treatment may be advisable, the passage of the catheter alone being practised. After the stricture has been fully dilated, the daily passage of an instrument for a few days subsequently is all that is required, the interval between the introduction of the catheter being gradually lengthened.

Fig. 359.



Mode of fastening catheter in the bladder.

The patient need not always be confined to bed during this treatment; but lie on a sofa or sit quietly in a reclining chair. When movement, however, causes irritation of the bladder, it must be forbidden.

In severe and neglected strictures this plan is one that ought always to be followed when possible, as it is sound in its principle, safe in its practice, and as expeditious as is consistent with the object aimed at.

Intermittent dilatation.

"The intermittent method" of dilatation is required in less severe cases, or where rest cannot be obtained; and can be carried out by the introduction of an instrument on one day, and after the lapse of one or two more, its re-introduction, followed immediately by the employment of a larger size, and then the next, and the next size larger still, till complete dilatation of the stricture has been effected. It is the second best plan the Surgeon has at his command, and although more tedious than the former, is in the end successful; patients so treated, however, require doubtless the more frequent introduction of a catheter to maintain the urethra in its dilated condition than others treated by the former plan. For this method of treatment metallic instruments are better than elastic.

Where stricture very contracted.

When a stricture is so contracted that a catheter cannot be passed even after very careful manipulation, the attempt should be given up and alkalies prescribed. When the urethra is irritable, opium, enforced rest, and the hip bath are of use; and after the lapse of a day or more, success may follow another attempt. When the stricture is reached by the catheter, gentle pressure upon it may be employed; indeed, pressure may be kept up for two or three minutes, the parts often yielding under its influence and allowing the instrument to pass. If this end be obtained, let the Surgeon be satisfied and leave the catheter in, whether silver or elastic, for should he remove it, he will in all probability fail to pass a second. If the instrument be silver, an elastic one should be substituted when it is removed.

Where catheter grasped and held tight.

When a catheter is grasped and "held" in the urethra, the operator may be tolerably sure that he has entered the stricture, and when its end is movable he may be equally sure that he is in a false passage. When the catheter has been held and passed forwards into the bladder, all is well, when it slips suddenly into a movable space, the urethra has probably been perforated. Under these circumstances, when a false passage probably exists, it is wise to give up local treatment for a few days to allow the parts to heal.

A stricture should be dilated up to its fullest extent.

It is important to bear in mind, that after the full dilatation of a stricture, contraction will again take place after a time, if the passage be not kept open; but the introduction of a catheter once in every two, three, four or more months according to circumstances, is generally sufficient to prevent such a result taking place.

On the splitting of strictures.

On splitting strictures.—What in modern language is called "*the rapid or immediate treatment of stricture*" is in reality its rupture or splitting—it being in all probability a rare thing for a stricture to be suddenly, fully, and rapidly dilated without being lacerated. The plan known by this name has certainly a taking title, and in practice, has apparent advantages which, if supported by experience, would establish its claims on the attention of Surgeons. In our day, it is known as that of Holt, but Holt's instruments are mere modifications of M. Perrève's made in 1847, and the same sort of practice has been adopted by Mr. T. Wakley; Dr. Hutton, of Dublin; Maisonneuve, Buchanan, and others.

Holt's instrument.

Holt describes his instrument "as consisting of two grooved blades, fixed in a divided handle, and containing between them a wire welded to their points, and on this wire a tube (which when introduced between the blades corresponds to the natural calibre of the urethra) is quickly passed, and thus ruptures or splits the obstruction."

The stricture having been split, the dilator should be rotated to separate further the sides of the rent, and then withdrawn; a catheter corresponding to the number of the tube being substituted for the purpose of removing the urine. This method, however, no more effects a permanent cure of a stricture than the plan of dilatation already referred to, since every hospital Surgeon has been called upon to treat cases of stricture that have been subjected to this plan and then have relapsed. Indeed, there is reason to believe, that after "*the rapid method*" an early relapse is more common than after others, and that the cicatrices of these split structures contract faster than the original. Bad, and even fatal effects, moreover, are more common *after* the splitting operation than after gradual dilatation.

Dilatation performed.

The plan of treatment by dilatation I have laid down is safe, and rarely followed by a fatal result; but this cannot be said after the splitting of the stricture, although facts are wanted to establish the proportion of fatal to successful cases.

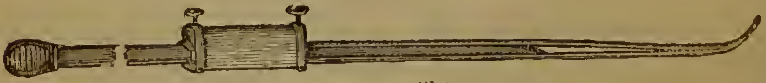
To narrow, ring or annular, subpubic or penile strictures, Holt's method is probably well adapted; but for indurated, ribbon, tunnel or complicated strictures, it is dangerous and unsuitable.

Stricture with vesical calculus.

When a stricture is associated with a vesical calculus and it is a matter of necessity, to cure the one before lithotomy is employed, the immediate method may be used; but it ought to be understood, that a greater amount of danger attends its practice than follows the more ordinary method.

The best instrument for this plan of treatment is that made by Weiss for Mr. B. W. Richardson, of Dublin. (Fig. 360.)

FIG. 360.



Richardson's dilator.

Other forms of treatment.—Yet all strictures cannot be treated by dilatation, for "cases occur occasionally which are so exquisitely sensitive that the passage of a catheter, however skilfully performed, is followed by such severe constitutional and local disturbance as to produce more harm than good, and in which it is clear some other method of cure must be employed; whilst there are others which are relieved by means of the catheter, and even fully dilated, but which have a tendency to re-contract immediately upon the omission of the treatment. In the former case the treatment aggravates instead of relieves the symptoms; in the latter it must be continued for life to preserve an open passage. Under such circumstances some other plan of treatment must be adopted;" and I believe now, as when the above words were written, "the most beneficial to be the external division of the stricture from the perinæum; and it is to the late Professor Syme that we are here especially indebted for having so ably recalled our attention to the treatment of such troublesome and painful cases" ('Guy's Reports,' 1858).

External division of stricture from the perinæum. When applicable.

The Surgeon must not, however, in all cases of irritable stricture come to the conclusion, that Syme's operation is required, as it is only in exceptional examples that it is needed. For in some, the irritability rapidly disappears under the use of the catheter, and in others rest, alkalies, and opium have a most beneficial influence. If these fail, the cutting operation may be performed.

Laminaria tents.

Recently the laminaria stalks have been employed for dilating stricture, but for perineal strictures they are dangerous, and are apt to break. For strictures at the orifice of the urethra, from the contraction of cicatrices they are most valuable, but for all other forms they are ill adapted. A laminaria tent swells to at least twice its diameter, and may be introduced into the urethra dry and left there, a small shield being fixed to one end to prevent its slipping into the passage.

Caustics.

Caustics are not, at the present day, much employed in the treatment of stricture; indeed, few use them. The practice in theory is neither sound, nor in its results certain, indeed it is probably injurious, since it is impossible to apply such a caustic as the potassa fusa to the seat of stricture alone, and, when tissues are destroyed by its influence, they will subsequently cicatrise and contract, and thus add to the mischief. The practice is not one in any way that can be recommended.

Otis's method.

Otis's method of treating stricture may be described as a combination of rupture and urethrotomy.

He asserts it to be applicable to all cases of stricture situated *anterior* to the bulb, and that it is a radical cure in nine cases out of ten.

The operation is performed by first stretching the stricture to the full; second, slightly cutting it by an instrument with a concealed blade; and third, at once dilating the urethra to a little more than its normal size.

After the operation the urethra is to be maintained at its full size by the daily passage of metal sounds until the incisions have healed.

Urethrotomy

is a comprehensive term, and includes the *internal* division of a stricture from the urethra as well as the *external* through the perinæum.

Internal urethrotomy.

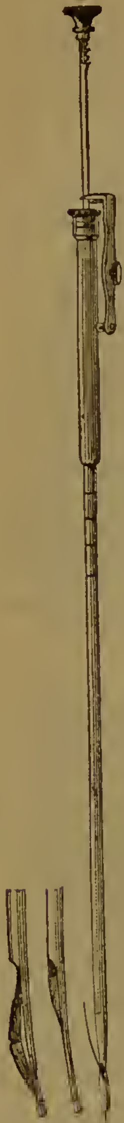
Internal urethrotomy has now many advocates, and in hard old strictures it is preferable to their rupture; for strictures also at the orifice of the urethra and within the penis it is a safe and valuable practice. In the hands of some surgeons it has been much practised advantageously, and Mr. Lund, of Manchester, has lately advocated it. Many instruments have been invented for the purpose, and Stafford's instrument, made in 1827, is well known. Fergusson employed a long grooved director, which he passed through the stricture, and a very narrow-bladed knife, which can be buried in the groove. Many ingenious instruments have been invented, but the best is that which divides the strictures from behind forwards on its withdrawal, such as that represented in Fig. 361. It is one that I have had made on Trélat's principle, perforated at its end for a guide bougie. In strictures of the orifice a bistoury may be used.

Instruments.

After the division of the stricture, it was a common custom to pass a large catheter into the bladder and leave it in, but M. Gouley has fairly shown that such a practice is not required. In orificial strictures after their division, the laminaria tent is the best to use with a shield.

Maisonneuve employed a filiform gum-elastic bougie as a guide through the stricture, as well as a grooved steel director which is screwed to the bougie and pushed into the bladder when the stricture had been divided.

FIG. 361.



Urethrotome, perforated at end for guide bougie.

Subcutaneous perineal urethrotomy has been practised, but my own experience of it has not been favorable.

External urethrotomy.

External urethrotomy is a valuable operation in selected cases, and includes three very different measures; *one*, in which the stricture is divided through the perinæum upon a grooved director passed through the stricture (*external division* or Syme's operation). The *second*, in which the urethra is opened in front of the stricture and a grooved probe passed through it into the bladder previous to its division (Wheelhouse's operation). And the *third*, in which the perinæum is laid open *without* a urethral guide—the stricture being impervious—and to this the term *perineal section* ought to be confined (Cock's operation).

Perineal section.

Syme's operation.

Syme's Operation,

as already stated, is valuable in the highly irritable as well as contractile stricture, in cases which Syme described as strictures that "continue to present symptoms after being dilated," and that "are indomitable by the ordinary means of treatment." It is, moreover, usually successful.

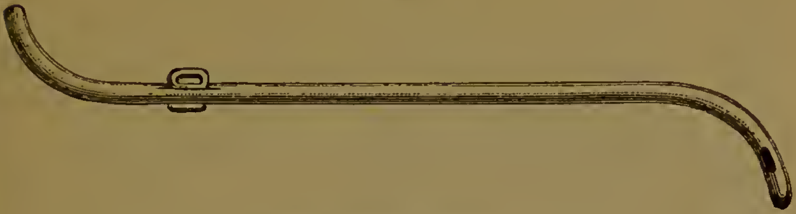
The operation is by no means one of difficulty. A grooved straight staff as large as can be passed through the stricture is first introduced, the patient having been placed upon his back, as if about to be cut for stone. The Surgeon should then with perfect precision introduce his knife into the centre of the perinæum, and at one stroke, cut down upon the groove situated at the lower border of the staff, and using this as his guide, divide the perineal portion of the urethra in which the stricture is situated. There are but two important points to be observed in this the second step of the operation; the first is to be certain that the knife occupies the groove of the staff, and secondly that the whole of the diseased or strictured portion of the urethra is freely divided. Having succeeded in this, the essential part of the operation, and after a grooved probe or director has been introduced into the bladder through the perineal wound, the sound may be removed, when either a full-sized elastic catheter can be readily introduced through the penis into the bladder and fixed in; or Syme's catheter (Fig. 362) may be introduced through the perineal wound for twenty-four hours.

Points to be attended to.

After-treatment.

The patient should then be sent to bed, and a mild opiate given, such as ten grains of Dover's powder, if much general or local vesical irritability exists. The catheter may be left in for several days if it fail to cause pain, but if the bladder resents its presence it may be removed; indeed more extensive experience has led me to think that the presence of a catheter is scarcely required for three or four days after the operation, when it should be passed and left in during the healing process.

FIG. 362.



Syme's perineal catheter.

Occasional use of catheters necessary.

After the wound has closed, the occasional introduction of a catheter is essential, and I cordially agree with Professor Syme in thinking "prudence requires that every patient who has had a stricture divided should learn to introduce bougies, since by doing so, at intervals of a week or a fortnight, he will be perfectly secure from future trouble." The division of a stricture no more effects a permanent cure than its dilatation or rupture, and occasional dilatation is essential to maintain its patency.

Wheelhouse's Operation.

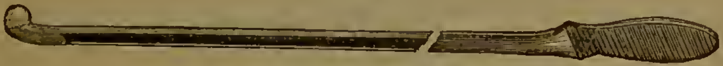
Mr. C. G. Wheelhouse, of Leeds, has introduced an operation for impermeable stricture, which I believe deserves attention. He states that in his hands and in those of his colleagues it has been most successful.

The instruments required for its performance are as follows:

Operation described.

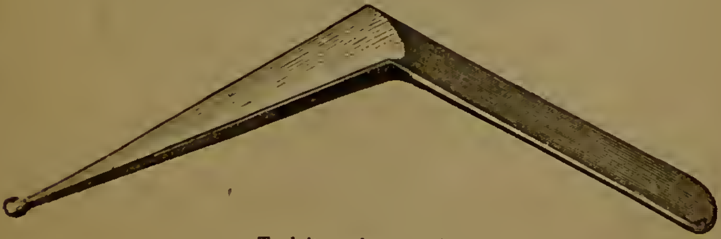
"Lithotomy bandages; a special staff, fully grooved through the greater part, but not through the whole, of its extent, the last half inch of the groove being 'stopped,' and terminating in a rounded button-like end (Fig. 363); an ordinary scalpel; two pairs of straight-bladed forceps, nibbed at the points; ordinary artery forceps and ligatures; sponge; a well-grooved and finely probe-pointed director; Teale's probe-gorget (Fig. 364); a straight probe-pointed bistoury; a short silver catheter (No. 10 or 11 gauge), with elastic tube attached.

FIG. 363.



Grooved staff, with button-like end.

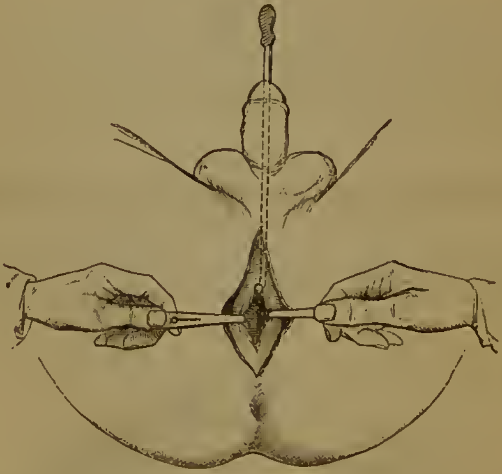
FIG. 364.



Teale's probe-gorget.

"The patient is placed in lithotomy position, with the pelvis a little elevated, so as to permit the light to fall well upon it, and into the wound to be made. The staff is to be introduced with the groove looking towards the surface, and brought gently into contact with the stricture. It should not be pressed much against the stricture, for fear of tearing the tissues of the urethra, and causing it to leave the canal, which would mar the whole after-proceedings, which depend upon the urethra being opened *a quarter of an inch in front of the stricture.* Whilst an assistant holds the staff in this position, an incision is made into the perinæum, extending from opposite the point of reflection of the superficial perinæal fascia to the anterior edge of the sphincter ani. The tissues of the perinæum are to be steadily divided until the urethra is reached. This is now to be opened *in the groove* of the staff, *not upon its point,* so as certainly to secure a quarter of an inch of healthy tube immediately in front of the stricture. As soon as the urethra is opened, and the groove in the staff fully exposed, the edges of the healthy urethra are to be seized on each side by the straight-bladed nibbed forceps, and held apart. The staff is then to be gently withdrawn, until the button-point appears in the wound. It is then to be turned round, so that the groove may look to the pubes, and the button may be hooked into the upper angle of the opened urethra, which is then held stretched open at three points thus (Fig. 365), and the operator looks into it immediately in front of the stricture. Whilst thus held open, the probe-pointed director is inserted into the urethra; and the operator, if he cannot see the opening of the stricture, which is often possible, generally succeeds in very quickly finding it, and passes the point onwards *through* the stricture towards the bladder. The stricture is sometimes hidden amongst a crop of granulations or warty growths, in the midst of which the probe-point easily finds the true passage. This director having been passed on into the bladder (its entrance into which is

Fig. 365.



Wheelhouse's operation of opening urethra.

clearly demonstrated by the freedom of its movements), its groove is turned *downwards*, the whole length of the stricture is carefully and deliberately divided on its *under* surface, and the passage is thus cleared. The director is still held in the same position, and the straight probe-pointed bistoury is run along the groove, to insure complete division of all bands or other obstructions. These being thoroughly cleared, the old difficulty of directing the point of a catheter through the divided stricture and onwards into the bladder is to be overcome. To effect this, the point of the probe-gorget is introduced into the groove in the director, and, guided by it, is passed onwards into the bladder, dilating the divided stricture, and forming a metallic floor, along which the point of the catheter cannot fail to pass securely into the bladder. The entry of the gorget into the latter viscus is signalised by an immediate gush of urine along it.

"The short catheter is now passed from the meatus down into the wound; is made to pass once or twice through the divided urethra, where it can be seen in the wound, to render certain the fact that no obstructing bands have been left undivided; and is then, guided by the probe-dilator, passed easily and certainly along the posterior part of the urethra into the bladder.

"The gorget is now withdrawn; the catheter fastened in the urethra, and allowed to remain for three or four days; the elastic tube conveying the urine away to a vessel under or by the side of the bed.

"After three or four days the catheter is removed, and is then passed daily, or every second or third day, according to circumstances, until the wound in the perinæum is healed; and, after the parts have become consolidated, it requires, of course, to be passed still from time to time to prevent recontraction."

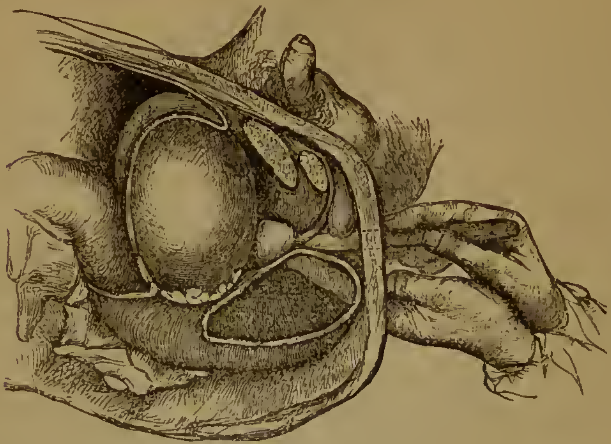
Perineal Section or Cock's Operation

is a more difficult and dangerous operation than Syme's, and is called for in far more severe cases, that is, when the urethra is impervious and no guide to the urethra exists beyond that which the Surgeon's knowledge of the anatomy of the parts affords. It should also be remembered that, as a rule, the normal anatomy has been nearly destroyed, for impervious strictures requiring urethrotomy are usually chronic, as well as complicated with extravasation, suppuration, or urinary fistulæ. Perineal section, when necessary.

The operation I shall describe is that one suggested by Mr. Cock, and known by his name; "the objects aimed at in the operation can be accomplished, while I doubt if those of any other have ever been fulfilled. However complicated may be the derangement of the perinæum, and however extensive the obstruction of the urethra, one portion of the canal behind the stricture is always healthy and often dilated, and is accessible to the knife of the Surgeon. I mean that portion of the urethra which emerges from the apex of the prostate, a part which is never the subject of stricture, and whose exact anatomical position may be brought under the recognition of the finger of the operator. Thus, when we cannot introduce a catheter by the ordinary method, and even when we cannot tap the bladder through the rectum, it still remains to us *to tap the urethra as it emerges from the prostate*, and thus to effect the desired communication." Cock's operation.

The operation which Mr. Cock has described as "tapping the urethra at the apex of the prostate, unassisted by a guide staff," is performed in the following manner, and illustrated in Fig. 366. I have seen Mr.

Fig. 366



Mr. Cock's operation of tapping the urethra at the apex of the prostate, or perineal section.

Mode of performance of external urethrotomy without a staff.

Cock frequently perform it, have done it myself on many occasions, and have no hesitation in strongly recommending it as *the* operation for external urethrotomy without a staff. The only instruments required are a *broad* double-edged knife with a very sharp point, a large silver probe-pointed director with a handle, and a catheter.

'Guy's Hosp. Rep.,' 1866.

"The patient," writes Cock, "is to be placed in the usual position for lithotomy; and it is of the utmost importance that the body and pelvis should be straight, so that the median line may be accurately preserved. The left forefinger of the operator is then introduced into the rectum, the bearings of the prostate are carefully examined and ascertained, and the tip of the finger is lodged on the apex of the gland; the knife is then plunged steadily but boldly into the median line of the perinæum, and carried on in a direction towards the tip of the left forefinger, which lies in the rectum (Fig. 366). At the same time, by an upward and downward movement, the vertical incision may be carried in the median line to any extent that is considered desirable. The lower extremity of the wound should come to within half an inch of the anus.

"The knife should never be withdrawn in its progress towards the apex of the prostate; but its onward course must be steadily maintained until its point can be felt in close proximity to the tip of the left forefinger. When the operator has fully assured himself as to the relative position of his finger, the apex of the prostate, and the point of his knife, the latter is to be advanced with a motion somewhat obliquely either to the right or the left, and it can hardly fail to pierce the urethra. If in this step of the operation the anterior extremity of the prostate should be somewhat incised, it is a matter of no consequence.

"In this operation it is of the utmost importance that the knife be not removed from the wound, and that no deviation be made from its original direction until the object is accomplished. If the knife be prematurely removed, it will probably, when reinserted, make a fresh incision, and complicate the desired result. It will be seen that the wound, when complicated, represents a triangle, the base being the external vertical incision through the perinæum, while the apex, and consequently the point of the knife, impinges on the apex of the prostate. This shape of the wound facilitates the next step of the operation.

Description of Cock's operation continued.

"The knife is now withdrawn, but the left forefinger is still retained in the rectum. The probe-pointed director is carried through the wound, and guided by the left forefinger, enters the urethra, and is passed into the bladder. The finger is now withdrawn from the rectum, the left hand grasps the director, and along the groove of this instrument the catheter is slid until it enters the bladder.

"The operation is now complete, and it only remains to secure the catheter in its place with four pieces of tape, which are fastened to a girth round the loins.

"A direct communication with the bladder has now been obtained, and the relief to the patient will be immediate; unless the kidneys have become irremediably disorganised, we may confidently anticipate a favorable result; and the restoration of the urinary organs will be more or less complete, in proportion as the obstructed portion of the urethra is more or less amenable to the ordinary judicious treatment of stricture.

"The catheter may generally be retained in the bladder for a few days, and if the state of the urine renders ablution necessary the viscus may be frequently washed out. The catheter may then be removed, cleansed, and reintroduced.

"If the previous destruction has not been very great, and if the case progresses favorably, the swelling of the perinæum and scrotum gradually subsides, the induration disappears, and the urinary sinuses become obliterated. The urethra may then be examined in the ordinary way, to test its permeability, and one may be agreeably surprised to find that the sound or catheter readily passes through the former stricture into the bladder; its passage may, if necessary, be facilitated by passing a director through the perinæum into the bladder, and guiding the catheter along its groove. The urethra, once restored to its normal condition and calibre, the artificial opening through the perinæum soon heals up, and, barring the liability of stricture to return if not attended to, the cure may be said to be complete.

"We must not, however, always expect so favorable a result. I have operated in several cases where the obstruction of the canal was complete, and impermeability permanent."

Continuation of Cock's description.

"In such cases the patient is condemned to pass his water through the artificial opening in the perinæum, unless a new passage should be bored to unite the upper and lower portions of the patient's urethra—an operation which I have seldom or never known to be successful."

"The necessity of micturating through the perinæum may seem to be a considerable hardship, but with a little arrangement the inconvenience is not very great; and be it remembered that the man's micturition is merely assimilated to that of the other sex.

"To keep the artificial passage in a permeable state it is generally necessary to pass a flexible bougie through the opening occasionally, and to retain it *in sitû* for a few hours. The patient very soon learns to do this for himself.

"I have now under my frequent observation two men, on one of whom I operated twenty-five years ago, on the other twenty; and both are thankful for their condition.

"I have not found this operation, with its result, in a permanent factitious urethra, at all interferes with the sexual function, although it is, of course, a complete bar to procreation."

I have described fully this admirable operation in the words of its originator, and believe it to be the only form of perineal section that ought to be performed in an impervious urethra. It is not sufficiently known. In exceptional cases the Surgeon may examine the urethra itself with the view to find a passage through it; and for this purpose use as a guide to its distal end a grooved staff introduced through the penis down to the obstruction; the two sides of the urethra being held well apart by forceps, or as suggested by Avery a loop of silk introduced through each edge of the divided urethra. If the Surgeon be fortunate enough to slip a fine grooved director through, the stricture will be readily divided. Under these circumstances a catheter should be passed through the penis into the bladder, and the one which had been introduced through the perinæum withdrawn. I need hardly say, however, that it is very rare for the Surgeon to be able to trace the urethral passage through the stricture.

Complications of Stricture.

Complications of stricture.

I have thus far dwelt upon *permeable* and *impermeable* organic stricture and its treatment, but have made only passing reference to its complications. I propose now to consider these points more fully, including *perineal abscess, extravasation of urine,* and *perineal fistula,* all of which are the direct results of stricture, and of local or diffused urinary extravasation.

Extravasation of urine is a complication which will almost necessarily follow a neglected stricture, and the pathological process by which it is produced has been already described. It is one of the means which nature adopts to find an outlet for urine when the natural passage has become so contracted as to forbid its flow. It is a complication of great danger, and requires in its treatment great decision on the part of the Surgeon; the effect of retained and often putrid urine upon any tissue of the body, being generally followed by sloughing. The early detection, therefore, of the beginning of an extravasation is important, and requires a few remarks.

Perineal urinary abscess. Symptoms.

Perineal abscess.—If a patient, the subject of a stricture, appears before a Surgeon suffering from more or less severe febrile symptoms, a parched skin, dry tongue, and a rapid irritable pulse, with or without an occasional rigor, a careful examination should be made of the perinæum and the parts around, and whether there exist any local symptoms sufficient to have attracted the notice of the patient or not, a circumscribed and almost solid mass will probably be discovered in the region of the bulb, which on firm pressure will be painful. The patient will frequently state that this has existed for some weeks and cannot be the cause of all his symptoms. The Surgeon, however, must not be misled, since this circumscribed mass is in effect a urinary abscess, the result of a local and limited extravasation, and the symptoms will only disappear when its contents have been evacuated.

Treatment.

TREATMENT.—If the urethra be examined, the stricture will almost to a certainty be found much contracted, and the stream of urine very small. Some discharge from the urethra may perhaps be observed, a little of the pus contained within the abscess behind the stricture making its way by the natural passage. If an instrument be made to pass the stricture, it may then only enter the dilated, ulcerated, and suppurating cavity of the abscess situated behind, and it will be a matter of difficulty to find the vesical end of the urethra, and, as a consequence, the instrument will be passed onwards into the bladder in only exceptional cases.

Abscess to be laid open.

The abscess itself must be opened and its contents evacuated; for if not, it will to a certainty increase, and being bound down by the perineal fascia, pass backwards and spread mischief around the neck of the bladder, and, in the cellular tissue of the pelvis, to the serious injury of the sufferer.

Stricture to be attended to.

At the same time the treatment of the stricture is to be remembered, as no treatment can be regarded as scientific if it be not directed to remedy the stricture, which is the cause of the abscess.

Division of stricture.

I am well aware some Surgeons are satisfied to open the abscess in the perinæum, and leave the stricture to be subsequently treated by dilatation or other means; but such a measure is temporising, and the soundest and most correct practice is to open the abscess, and at the same time to divide the stricture. This is readily done by passing a grooved staff through the urethra into the abscess, if not into the bladder, and freely dividing all the tissues by a scalpel introduced through the perinæum. If the orifice of the vesical end of the urethra can be detected with a probe, a large catheter may be passed and left in, but this point is not of any importance, as by the operation the Surgeon is certain that the stricture has been divided, all pus freely evacuated, the possibility of further extravasation taking place prevented, and a free outlet for the urine at the same time been obtained.

By adopting this practice much time is saved, the stricture being treated and probably cured by the same means that are absolutely essential for the treatment of the complication.

When, however, perineal abscesses occur unconnected with stricture, they should be opened early to prevent their breaking into the urethra and degenerating into urinary fistula. External urethrotomy under these circumstances is not required.

Extravasation of urine.

Extravasation of urine.—The complication of extravasation of urine does not always appear as a local and confined extravasation or as a urinary abscess. It not rarely shows itself as an extravasation of a severer nature; as one more sudden and marked in its symptoms and more fatal in its effects, requiring also at the hands of the Surgeon active and energetic treatment. It occurs as the result of a sudden rupture of the urethra from internal injury or giving way of the walls of an abscess communicating with it, the rupture taking place suddenly during some effort of a patient, the subject of a narrow and contracted stricture to relieve his distended and overcharged bladder.

Symptoms.

The *symptoms* by which the complication is manifested are very marked. The patient will probably relate that during some sudden expulsive effort to pass his urine, he felt something give way, and that this sensation was attended with relief to the symptoms caused by the retention of urine. He will soon discover, however, that the relief which he experienced was not the result of a flow of urine from the natural passage; and from the rapid enlargement of the perinæum, scrotum, and penis, will be convinced that something wrong has taken place. This swelling will be attended by a burning pain in the parts thus gradually enlarging, and will be increased at each effort made to relieve the distended bladder. The absence of pain on the first onset of the extravasation may delude the patient into a false idea of relief and safety.

Local conditions.

The Surgeon, if now called to see the patient, will find him labouring under retention of urine, with the perinæum, penis, and scrotum more or less swollen, and œdematous from urinary infiltration; the extravasated fluid, perhaps, having made or making its way upwards over the abdominal parietes even to the thorax. If the symptoms have existed long, a peculiar inflammation and gangrene of the integuments will made its appearance, and all the constitutional symptoms described as typhoid will certainly be present.

Treatment.

Under these circumstances the Surgeon, in his treatment, has three objects to keep in mind.

Objects to keep in mind.

First, to free the tissues, already infiltrated, of their extravasated urine, and thus prevent their total destruction.

Second, to secure a free and ready outlet for the urine from the bladder, and thus relieve the retention and prevent an extension of the mischief.

Third, which is no less important, to cure the stricture, and thereby remove the cause on which the complication originally depended.

Free incisions. Catheterism.

The first object is to be secured by free incisions made through the integument into the infiltrated cellular tissue; the second may perhaps be fortunately secured by the passage of a catheter, but this success is exceptional, and in the majority of cases the second and third indications are carried out either by the external division of the stricture, or by the perineal section as just described. A small grooved staff may be passed in by far the majority of cases, the employment of some force being perfectly justifiable to make it pass through the strictured portion.

Perineal incision.

Urinary fistulæ.

Urinary fistulæ.—These may be the result of a urinary abscess bursting in the perinæum or scrotum, or the consequence of a more diffused urinary extravasation, the fistulæ, under these latter circumstances, appearing in the perinæum, scrotum, groin, thighs, pubes, or nates (Fig. 367). They are generally the direct consequence of some urethral obstruction. Occasionally, however, they follow an accidental wound in the perinæum or urethra, or some such operation as lithotomy.

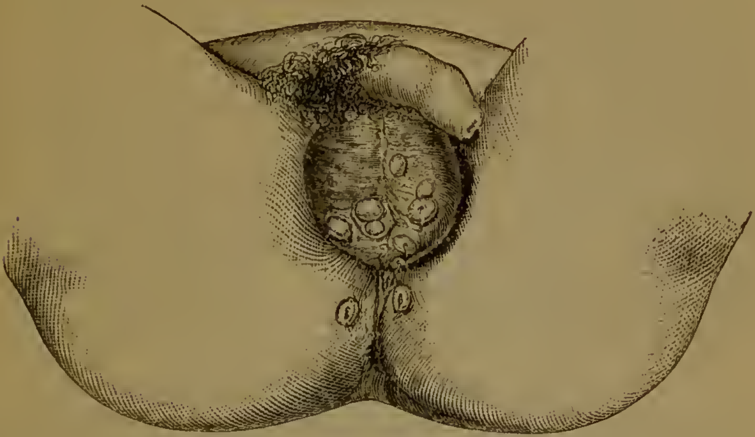
When simple.

When the fistulæ are simple tracts communicating with a urethra behind a stricture, and the tissues through which they pass are healthy, they need not be regarded with any anxiety, as, in all possibility, they will rapidly heal so soon as the urine flows readily the natural way after the dilatation of the stricture.

When complicated.

When, however, the fistulæ pass through indurated and diseased tissues and are associated with a contracted if not impermeable urethra, or are the result of some urinary extravasation and sloughing of the parts, the same success is not always secured. It is true that in a large number of cases when the stricture is dilated and cured, the fistulæ will close, but in exceptional cases they refuse to heal, and require the local stimulation of some such escharotic as the nitrate of silver, liquor ammoniæ, tincture of cantharides, the galvanic or actual cautery, to stimulate the indolent passage and assist its contraction.

FIG. 367.



Urinary fistulæ, the result of stricture.

Treatment.

It should be remembered, however, that in all these cases it is the entrance of the urine into the fistulæ which prevents their contraction and closure, and that any means by which such an occurrence can be prevented will be followed by recovery. To allow the patient to pass his urine is most injurious, and to pass a plugged catheter into the urethra and leave it in will not suffice, as daily experience proves that urine soon flows by the side of the catheter and enters the fistula.

Use of catheter.

The best plan is, to have a catheter passed whenever the bladder requires to be emptied; and if the Surgeon has dilated the stricture to its full size, and instructed the patient to pass an elastic catheter into the bladder, there are very few instances of urinary fistula that require further treatment. Where this practice cannot be followed, the introduction of a soft catheter into the bladder, with its end open to allow the urine to flow away as secreted, is to be advised.

When difficulty is experienced in dilating the stricture, Syme's operation may be performed, the Surgeon when he can, laying open the fistula at the same time.

Fistula after lithotomy.

The urinary fistula following lithotomy is best dealt with by the galvanic cautery and catheterism. In these cases, however, the Surgeon should always investigate the case sufficiently to assure himself of the absence of a second stone, or of a foreign body within the wound, for

I have known in one case a sponge, that had been applied to arrest bleeding, left in the wound and prevent repair. In another, a second calculus was overlooked, and prevented recovery; the fistula healed when the stone had been expelled by natural efforts through the fistulous perineal opening. I have likewise seen two cases where some calculous formations took place in the wound and thus kept it open.

Fistula opening into rectum.

Urinary fistula the result of an abscess communicating with the rectum will generally heal as soon as the urine is prevented from entering the passage. The use of the catheter will sometimes effect this; at others, position will suffice. Sir H. Thompson gives a case in which recovery followed the practice of micturating in the prone position for a month. But any means that for a time prevents the passage of urine into the fistula will probably suffice to allow of its contraction. When this does not succeed, the passage may be stimulated by the galvanic or other cautery, and, in exceptional cases, a plastic operation may be called for.

Fistula with loss of tissue.

The urinary fistulæ associated with loss of tissue, whether in the penis, scrotum, or perinæum, require the greatest amount of ingenuity in the Surgeon, as, besides the constriction of the normal channel, some plastic operation is often necessary.

On Cicatricial or Traumatic Stricture.

Traumatic stricture.

History and causes.

The difference in the cause, the permanency in the nature of a so-called traumatic stricture, and the difficulties in the treatment, have led me to separate the cases thus denominated from that larger class which we have been just considering, the result of local inflammations; and from my notes of forty-three consecutive examples of this kind, in all of which a distinct history could be obtained of some definite accident affecting the perinæum, the blow or fall was immediately followed by hæmorrhage from the urethra, with or without other symptoms, and, at a later date, by difficulty in micturition.

As a rule, these accidents take place in boyhood or in young adult life, though no age is free from the dangers of such an injury, and the kick of a man or horse on the perinæum, a fall upon a pointed instrument, or across a bar, beam, or rail; an injury from a saddle when riding, a blow from a rope, and sloughing of the perinæum after a violent contusion, are the principal causes to which the stricture has been assigned in the cases before me. In one and all there was clear evidence, at the time of the injury, that the urethra was more or less involved, as hæmaturia in almost every case immediately followed, while difficulty in micturition appeared subsequently at variable intervals. In some few cases, several years had passed away before the attention of the patient was called to the smallness of his stream of urine, when some sudden attack of retention was the first symptom which attracted notice; but, in the majority of cases, the difficulty of micturition appeared rapidly after the receipt of the primary injury, and went on slowly but surely to increase.

Pathology.

The pathology of these cases is not difficult to understand. The urethra, by the injury, is either partially or wholly ruptured, the wound being irregularly transverse; union takes place, and subsequently contraction of the cicatricial tissue, with a narrowing of the urethra and the formation of a traumatic stricture follow. It is this pathological fact which enables us to explain the obstinacy of the symptoms and the difficulty in the treatment.

Complications. Complications.—Traumatic stricture is as liable as any other organic stricture to be followed by the complications: these complications being the result of the obstruction to the urethra, in whatever way that obstruction may primarily have been caused. Among my forty-three examples of traumatic stricture, twenty-seven were admitted simply on account of their contracted stream and difficulty in micturition; in eight, retention of urine was the immediate cause; in three, extravasation of urine; and in five, urinary fistula complicated the cases.

Treatment. TREATMENT.—There are no cases of complicated or non-complicated organic stricture more obstinate in their treatment than the traumatic, and the nature of the obstruction being cicatricial is quite sufficient to account for this fact, since it is well known that all cicatrices have a constant and almost perpetual tendency to contract. A traumatic stricture, the result of a contracting cicatrix, is consequently in its nature essentially a contractile stricture, and its treatment is, therefore, very troublesome. When treated by dilatation, it will re-contract, and even if treated by perineal section or external division, it is far more likely to return than any form of inflammatory stricture.

Its obstinacy All forms of treatment are consequently uncertain and unsatisfactory. If dilatation of the urethra is once secured, the introduction of a catheter at short intervals is most essential, or otherwise the canal is certain to re-contract; and if it is doubtful whether any case of simple inflammatory stricture is ever really cured it may unquestionably be asserted that a traumatic stricture will exist for life, and that it will require constant and repeated treatment to preserve even a moderate patency of the narrowed passage. The principles of treatment in both varieties, however, are the same, although the practice may not be so successful.

Dilatation. If the urethra be permeable, the treatment by dilatation should be primarily employed, and persevered in for some time if success is to be secured. If the stricture is so narrow and indurated as to resist dilatation, and a grooved staff can be passed through, the operation of external division is the soundest practice, and gives the surest hopes of immediate and future benefit.

Perineal section. If the stricture be impermeable, and from its narrowness require immediate treatment; or should its complications, either of extravasation or urinary fistula, demand attention, the perineal section must be carried out in the same manner as in the cases previously referred to.

If extravasation of urine be present as a secondary result of this traumatic stricture, the same principles and practice which have been advocated in the treatment of simple organic stricture are equally applicable; as are also the recommendations which have been made for the treatment of perineal fistula.

In cicatricial stricture, where the urethra has so contracted as to render the passage of a catheter impracticable, the establishment of a permanent perineal fistula is sometimes demanded.

The permanent success, however, of the practice in these traumatic cases is not nearly so great as in the inflammatory, although the practice in both is really the same. It is hardly necessary to illustrate these facts, as the experience of all Surgeons will bear them out.

Statistics of results in treatment.

To show the greater severity of these cases and the difficulties of their treatment by dilatation, it may be stated that out of the forty-three examples of traumatic stricture which have been tabulated, in six, or 14 per cent. of the whole number, the operation of perineal section or of external division was absolutely required; whereas, amongst the cases of simple organic stricture, only 6 per cent. required such operative interference—the simple treatment by dilatation answering every other purpose.

The causes of Death from Stricture.

Causes of death from stricture.

There are few local diseases which, if neglected, have a more fatal tendency than urethral stricture; and there are none in which the progress towards evil can be so accurately and clearly traced, from the portion of the urethra situated behind the stricture which primarily experiences the evil influence of the obstruction, to the bladder which becomes secondarily involved, and last, but not least, to the ureters and kidneys. The importance of the kidneys in the animal economy as excretory organs receives thus a fresh demonstration from the fatal effects of disease in their structure.

Renal disease.

To assert that renal disease is the sole cause of death from stricture would not, perhaps, be strictly true; nevertheless, it is the principal one, and if these glands are not involved, stricture and its complications are not fatal.

Simple uncomplicated stricture is not a fatal disease, few cases terminating in death.

Stricture and retention of urine is a more serious combination, and stricture with extravasation of urine is still more fatal.

It would thus appear that it is only when stricture has existed for a lengthened period and become complicated, that its fatal influence becomes apparent—the increase in the mortality of the cases increasing with the severity of the complication.

Influence of duration of stricture.

The duration of the stricture has necessarily a serious influence in producing a fatal result; the longer the obstruction exists, the greater the probability, if not certainty, of the production of renal affection.

In 26 fatal cases, the notes of which are before me, the average duration of the stricture was seventeen years; in 5, symptoms had existed under ten years, and in 10, for upwards of twenty years.

When stricture, therefore, has existed for a long period, and more particularly when it has been neglected, it may be inferred with certainty that some disease of the kidneys has been produced, and that the slightest injury or accession of mischief is likely to terminate in death; for every subject of renal disease stands, as it were, continually on the edge of a precipice over which the slightest adverse wind may send him, and the fatal results of many operation cases, whether upon the urinary organs or other parts, are to be thus explained; for no subject of renal disease is able to resist the slightest tax upon his powers, and his vital energy sinks irrecoverably upon the receipt of the most trifling injury.

Summary of treatment of stricture.

By way of summary of the treatment of stricture the following conclusions may be drawn:

1. At least ninety-five out of every hundred cases of stricture are

readily and safely dilated by means of catheters, and every stricture might be so treated if recognised before any complications appeared.

2. Of *permeable strictures*, it is only in the obstinately irritable and contractile forms that any other treatment is called for; and in these, external division, by the plan recommended by Syme, is probably the best operation; though *rapid dilatation*, *splitting*, or internal division of the stricture, may be justifiable under exceptional conditions.

3. Strictures complicated with *urinary abscess* or *extravasation*, in which perineal incisions are called for, should be treated by external division or Syme's operation, when a staff can be passed through the stricture; and by perineal section, Wheelhouse's or Cock's operation, when no such guide can be employed.

4. In strictures complicated with *urinary fistulæ*, the stricture itself should be treated, since the fistulæ usually close as soon as the urethra has been fully dilated. When this result does not take place, it is essential that all urine be prevented passing into the fistulæ, and the best means to ensure this is, by the passage of the catheter whenever relief is required.

5. The *external division* of the stricture is an excellent operation in obstinate cases of permeable, contractile, and irritable strictures; in all cases of extravasation of urine in which perineal incisions are called for, and also, in long indurated strictures complicated with urinary fistulæ.

6. *Perineal section*, Wheelhouse's or Cock's operation is good in all cases of impermeable stricture or obliterated urethra, complicated or not with urinary abscess or fistula, in which a free outlet for the escape of urine is essential.

7. *Internal urethrotomy*, except in penile or in the obstinately irritable or contractile strictures, is not often required, and the treatment by caustics is dangerous.

8. *Cicatricial strictures* should be treated as others; but they are far more obstinate, and require more frequently external urethrotomy.

On Ruptured Urethra.

Rupture of urethra.

The secondary effects of an injury to, or a rupture of, the urethra have already been considered under the heading of traumatic stricture; and it has been shown that, in at least 6·65 per cent. of the cases of organic stricture, an injury was the assigned cause. It has also been shown that the worst and most intractable cases of stricture, as well as the majority of examples of obliterated urethra, are of this kind.

Mode of occurrence

I propose now to consider the subject of ruptured or injured urethra with its immediate effects and treatment. In the majority of instances the injury is caused by some direct violence applied to the perinæum, such as a fall against a post, plank, fence, or chair, a blow or kick on the perinæum. In not a few instances, the injury has been produced by the passage of a cart wheel across the pelvis, although it may be somewhat difficult to understand how such a result can be produced by this cause, unless some fracture of the pubic portion of the pelvis coexists; but explain it how we may, in practice we meet with cases of ruptured urethra following the passage of a wheel across the pelvis, and unconnected with any other distinct evidence of fracture.

Symptoms.

Symptoms.—The characteristic symptom of a rupture or laceration of the urethra is the passage of blood from the penis unconnected with micturition. The blood appears usually as an immediate result of the injury, and may be little or profuse in quantity; it seldom endangers life, and, as a rule, subsides without treatment. If the injury has been but a superficial tear in the mucous membrane, it is just possible that this is the only symptom by which the laceration can be recognised; and if some time has elapsed between its receipt and the calls of nature to relieve the bladder, micturition may be completed with little or no difficulty, and convalescence re-established.

It is not often, however, that the subject of a lacerated or ruptured urethra escapes so easily, for in the majority of cases, retention or extravasation of urine is the result, and for the relief of this the advice of the Surgeon is generally at once sought.

Treatment.

Catheterism.

Treatment.—When called to attend a patient who has been the subject of an injury to the urethra suffering from simple retention, the first object of the Surgeon is to attempt the passage of a catheter; and, if the urethra be not completely torn away and there is not much blood locally effused, there is a strong probability that he will succeed. A gum elastic instrument, with a strong stylet, should be employed. Having accomplished this, the instrument should be fastened in, and the urine allowed to flow away as secreted, being conducted at once by means of a tube into a vessel placed close at hand; for, if the catheter be plugged, urine is sure to find its way by its side into the perinæum. If the attempt at catheterism fail, some other means must be employed to provide an outlet for the urine, otherwise extravasation, with all its danger, will necessarily follow. Under these circumstances an incision into the perinæum on a grooved staff passed down to the seat of laceration in the perinæum is unquestionably the soundest practice to adopt; as by this means the extravasated blood and urine find a ready outlet, and the bladder, when it contracts, a vent for its contents—the danger of extravasation of urine being thus prevented.

Perineal incision.

Treatment of the ruptured ends of urethra.

When the perinæum has been laid open, and the two ends of the divided urethra can be made out, they may be brought together by a suture; and if the orifice of the vesical end of the ruptured urethra can be found with a grooved probe, a catheter should be passed, the instrument having been first introduced through the penis, and subsequently guided upon the grooved probe into the bladder. If difficulty is experienced in finding the orifice, there need be no alarm, as it is quite clear that the urine will readily find its way externally through the artificial wound; nevertheless, an early attempt to pass the catheter should certainly be made, as it is most important that the continuity of the urethra should be restored as early as possible.

When a catheter has been introduced it must be left, since the patency of the canal should be maintained *during* the whole period of its repair, and its subsequent contraction in a measure neutralised.

The frequent passage of an instrument *after* the repair has taken place is an important point to be observed, this practice being the best guarantee that a cicatricial stricture cannot ensue. In the case of a man I treated seventeen years before for retention following a ruptured urethra by a perineal incision there has not since been any difficulty in micturition.

RETENTION OF URINE.

Retention of urine. Causes.

When a patient is unable to pass his urine he is said to be the subject of retention, which may be due to the presence of organic or cicatricial stricture, spasm of the urethra, urethral obstruction from inflammation of the urethra or prostate, urethral calculus, and many other local and general causes. Amongst the latter must be placed brain disease; and my friend Dr. Hess, of Finsbury Square, told me, in 1879, of the case of a gentleman who had a bladder so dilated that it reached up to the ensiform cartilage, and led the medical man in attendance to believe that *ascites* existed. There was, at the same time, very marked anasarca of the lower extremities up to the groins. All these symptoms, however, disappeared when ten pints of urine were drawn off. I have already stated, that retention existed in 129 out of 608 cases of organic stricture admitted into Guy's during seven years; and in 8 out of 43 cases of traumatic stricture. It was also present in 80 other cases, the result of varied general and local causes unassociated with stricture.

Statistics.

Spasmodic stricture was the assigned cause in half, *i. e.* it was found in subjects in whom no permanent narrowing of the canal existed. In almost all, excess of drinking, with or without exposure to wet and cold, were the exciting causes, and no complication aggravated the cases. One was in a boy, æt. 10, who paid the penalty of a drinking bout by suffering the pain of a retention. Catheterism relieved him. In all these forty cases spasm of the muscles of the urethra was the assigned cause.

Retention in a child is generally from stone impacted in the urethra; in an adult, from stricture; and in an old man, from prostatic disease.

Spasmodic Stricture as a cause of Retention.

Spasmodic stricture.

The existence of a *true spasmodic stricture* is no longer a subject of doubt. That the seat of the stricture is the membranous portion of the urethra, which is encircled by muscles, is also now generally acknowledged; and that the usual exciting causes are exposure to wet or cold, and excess in drinking, many cases before me clearly prove. Anything, however, which can induce an altered or acid state of the urine is likely to be followed by this complication, gouty and rheumatic patients being particularly liable to such attacks. The *treatment* of such cases is not difficult; the simple passage of a large metallic catheter being the most expeditious and certain practice. The instrument should be well warmed and freely oiled, and then passed slowly, so as not to excite alarm or increase the spasm of the muscles. In skilful hands its introduction is not an operation of difficulty. If, however, the operator be foiled in his endeavours, he must be cautious not to employ force, which is never required, and never justifiable. An anæsthetic should then be administered, and with a patient fully under its influence all obstruction ceases, while the instrument will pass into the bladder. If there be an objection to the use of the anæsthetic, the old remedy of *a hot bath* cannot be too highly extolled; few patients suffering

Causes.

Treatment.

Chloroform.

Bath.

Opiate.

from simple retention failing to micturate when thus immersed; by the bath the introduction of a catheter is likewise much facilitated. *A full opiate* is also an invaluable remedy, relieving the involuntary contraction of the bladder, which is so painful in cases of retention, and thus removing one of the most constant causes of spasmodic stricture. The value of opium in these cases, according to some, cannot be upheld too strongly; indeed they assert that there is no case of retention of urine which will not yield to its benign influence, allowing either a natural relief, or the introduction of a catheter. The inhalation of an anæsthetic I believe to be a preferable remedy, its action being more rapid and certain. If failure follow the application of these, other measures must be adopted; and without doubt the simplest, safest, and most expeditious practice is puncturing the bladder. I prefer to do this through the rectum; others above the pubes. In a simple spasmodic stricture, however, such a necessity can scarcely arise.

Inflammatory Stricture as a cause of Retention.

Inflammatory stricture.
Causes.

It has been already shown, that in spasmodic stricture, exposure to wet or cold, and an altered condition of the urine, produced either from excess of drinking, gout, or rheumatism, are the chief exciting causes of an attack of retention; and if this be true there can be no difficulty in understanding that a like result may be brought about, and is more liable to be experienced, if the urethra itself should be the seat of an inflammatory action. Retention of urine occasionally comes before our notice as a result and concomitant of gonorrhœa. The causes of the retention are evidently compound, viz. spasmodic stricture added to the mechanical obstruction produced by the œdema of an acute inflammation combining to produce the result.

Treatment.

The *treatment* required to afford relief must be based upon the appreciation of these two conditions which have combined to cause the effect. The retention is in a measure mechanical, and must be met by mechanical treatment; but it is also functional, and, as a consequence, must be so considered.

Catheterism.

The symptoms being urgent, time is, therefore, a great object; and if called to a case, there are few Surgeons who would not at once attempt to pass a catheter. Let the Surgeon choose an instrument of medium size, No. 4 or 5 being the best, taking care that it be well warmed and oiled, and then with gentleness and yet with firmness the obstruction may be overcome; *arte non vi* must be the guide to action, as force is to be condemned as much in these cases as it was in the preceding.

Opiates.

If these means fail, a hot bath and a full opiate are the soundest remedies. They relieve the local turgescence of the passage, and also the obstruction, and with it the associated spasm. In some instances the introduction of a piece of ice into the rectum serves a like purpose. The use of an anæsthetic in these cases cannot be recommended, as it merely relieves the spasm but does not alter the condition upon which the spasm depends, viz. the inflammation. When these means fail, which is not commonly the case, some operative measure may be required, which will be dwelt upon in another page.

Retention from blow in perinæum.

Retention of urine following a blow in the perinæum.—Under this heading it is not my intention to allude to cases of ruptured urethra, as this condition has already been considered. But cases of retention occasionally come under notice which follow a simple contusion in the perinæum. I possess three such records—two in children aged three and seven respectively, and one in an adult aged twenty-nine. In none of these cases could hæmorrhage or other symptom of ruptured urethra be made out. The retention followed the contusion, and was caused by some spasmodic condition of the passage excited by the injury. In all the cases, the simple passage of a catheter was the only treatment, and, with the relief of the symptoms, convalescence followed.

Retention from pressure of abscess.

Retention of urine from the pressure of an abscess in the perinæum must be mentioned, as cases of retention from such a cause occasionally come under notice, while abscess about the rectum is not unfrequently associated with such a difficulty. It should be treated by opening the abscess.

Retention from paralysis of bladder.

Paralysis of the bladder from any cause situated either in the organ itself or associated with spinal disease, is a common cause of retention, and the same complication may be found in fever or other constitutional condition in which the vital powers of the patient have been much reduced, and the nervous system has, as a consequence, become unable to answer to its accustomed stimulus. Retention of urine is also met with as a symptom of peritonitis, local or general, or as a result of some other abdominal disease. It is well for the Surgeon to remember, that this complication may be produced by the causes enumerated.

Incontinence of urine often present.

It is not to treat retention of urine, however, that the Surgeon is usually called to such cases, but for the incontinence of retention, the incontinence being merely the overflow of an already overdistended and engorged bladder. The symptom of incontinence is a very positive one, and should never mislead any practitioner. It is almost always a concomitant and result of retention, and at any rate should be so regarded until the Surgeon has convinced himself, by a careful examination, that the bladder is not distended.

Retention of Urine as a symptom of Enlarged Prostate, and in the Aged.

Retention from enlarged prostate.

It has been a common opinion, held by all Surgeons for many generations, that an enlarged prostate is a very general condition of old age, and retention of urine, as a consequence and symptom of this affection is of frequent occurrence. The investigations of recent pathologists have shown, however, that such an opinion is by no means correct; for although an enlargement of the prostate, either as an hypertrophy, or from the development of independent prostatic glandular tumours, may take place, and when it does, it is most commonly met with in old people, yet such a condition is by no means to be considered as a necessary senile change.

Treatment.

When retention of urine takes place in old people in whom no stricture exists, it is too frequently ascribed to this chronic enlargement of the prostate, and as it is really a rare thing to find such a condition in the bodies of those that die, it is fair to believe, that this retention is due to other causes, such as atony of the bladder, which may be relieved by the introduction of a large catheter. This operation should always be undertaken with great care, as an injury to the prostate or bladder in old people is of considerable consequence. An elastic instrument with a full curve, in the hands of those who are not in the constant habit of using instruments is to be preferred, and this may be passed slowly down to the neck of the bladder. It is at this point that the difficulty in its introduction is always experienced; but if the index-finger of the left hand be introduced into the rectum and the end of the instrument tilted upwards by the slightest pressure with the right hand, the catheter, as a rule, will be readily passed onward, and relief will be secured. The patient's pelvis should always be well raised before the catheter is used.

Retention of urine may also be produced by an abscess situated in the prostate gland, and the retention is only relieved when the abscess is opened. This treatment, therefore, is that which should be followed.

Retention of Urine as a result of an Elongated and Adherent Prepuce.

Retention due to an elongated prepuce.

It is a somewhat inexplicable fact that surgical writers have, with rare exceptions, omitted to notice that an elongated prepuce and adhesion of the glans penis to its mucous membrane covering, is capable of producing retention of urine with every symptom of vesical irritation; yet few Surgeons can have had much experience at any hospital or dispensary, particularly in out-patient practice, without seeing many such examples. I could quote cases in which an adherent prepuce had been the cause both of retention and of incontinence of urine, and in which it had produced symptoms of irritable bladder and every other symptom of vesical calculus, even hæmaturia, prolapsus recti, or constant priapism.

Variety of symptoms caused by adherent prepuce.

All, or nearly all these cases take place in early life, and I never see a case of vesical irritation in a male child without first examining the condition of the penis. I have been in the habit of pointing out this fact to students for some years, and have advised them to follow the practice suggested, under the conviction that in at least two thirds of the cases suffering from urinary irritation which pass under observation an adherent and elongated prepuce is the sole cause. Circumcision and the careful separation of the prepuce from the glans penis, with the removal of the confined secretion of Tyson's glands, is the only remedy, which is at once simple and complete.

Treatment.

On Retention of Urine from Organic or Cicatricial Stricture.

Retention due to organic stricture.

Among the many contingencies to which a patient suffering from organic stricture is continually exposed, none cause more agony and alarm, or demand more prompt and decisive action on the part of the Surgeon, than retention of urine.

The retention may be the result of a slowly contracting organic stricture; but it will probably be produced by some sudden accession of spasm of the muscles of the passage, and thus be compound in its nature, a spasmodic being grafted upon an organic stricture. The symptoms, however, are necessarily urgent, and it becomes an important question as to what practice should be pursued. With this object it will be of interest to inquire, first of all, what practice has been proved of value? and, as a means to the solution of the difficulty I can show, that out of 224 examples of retention from simple organic stricture, 184 were successfully treated by means of catheterism, warm baths, and opium. In 40 cases only, or 17·4 per cent., were any other operative measures called into requisition, and in all of these 40 examples the bladder was punctured per rectum with complete success,

Treatment.

Puncture per rectum.

and without any of the theoretical objections which have been adduced against the operation.

Out of 14 cases also of retention of urine produced by the gradual contraction of a *traumatic* stricture, 8 were treated by means of catheterism, and 6 by puncture of the bladder. The proportion of cases requiring such an operation being much greater in traumatic strictures than in the preceding class of simple organic stricture, the cause of this difference being very apparent.

Catheterism.

Puncture per rectum.

If a Surgeon is called to a patient suffering from retention of urine produced by either a simple spasmodic or an inflammatory stricture, it has already been explained that relief can be obtained by the cautious introduction of a catheter, aided, if required, by the use of the warm bath or a full dose of opium, and, in certain cases, by the inhalation of an anæsthetic. If these means fail, as experience proves may be the case, either from some peculiarity of the stricture, or the manner in which the treatment has been carried out, other measures will necessarily be called into requisition; and it has been already stated that the best and most expeditious practice is to puncture the bladder through the rectum. It is true that this practice is rarely needed in simple spasmodic or in inflammatory stricture, for the means already suggested are, in the majority of cases, amply sufficient to secure relief; nevertheless, in exceptional instances, this operation is of great value. It must be remembered, also, that the practice is only required when simpler means have failed.

Aspirator in retention.

Since the introduction of the "aspirator," many Surgeons have employed it with success in cases of retention, but relief by such a measure does not commend itself to my mind, being merely a temporising operation, and requiring frequent repetition in the same case; it has no such influence for good upon the cause of the retention as the operation of puncturing the bladder through the rectum. In exceptional cases of retention of urine it may be a justifiable proceeding.

Statistics.

Mode of proceeding in a case of retention from stricture.

In the treatment of retention of urine with simple organic or traumatic stricture, the same principles of practice should be applied as have been recommended in the former class of cases; and in a large proportion of instances it has been already shown that success by such treatment may be secured; since, out of 238 cases of retention admitted into Guy's, operative measures were required in only 46, and the simple introduction of a catheter, with the aid of warm baths and the internal administration of opium, proved sufficient to carry out all the objects required in 192. If the Surgeon is called, therefore, to a case of retention of urine with organic stricture, the introduction of a catheter is the primary means to be employed. If the history informs him that the retention is the result of a gradually contracting passage, a medium-sized instrument should be selected, and on this failing, a second attempt with a smaller one may be followed by success. Force, however, must not be employed, and too much time should not be expended in making the attempt. If success is to follow the operation, it will readily be obtained; perseverance and repeated endeavours to pass an instrument, as a rule, do harm. If the symptoms are not very urgent, and some delay may be allowed, the warm bath and a full opiate, such as two or even three grains of opium, may be employed; and, under their combined influence, it will be only in exceptional cases that relief will not subsequently be secured.

When ordinary means fail.

If the symptoms of retention, however, are very urgent, and the agonies of the sufferer demand immediate relief, or if the means which have been just described have been found wanting after a fair trial, there is little doubt that the most scientific and certain practice is the puncturing of the bladder through the rectum; for all experience has correctly endorsed the opinion expressed by Mr. Cock when he recalled the attention of the profession to this operation in his valuable paper, published in 1852 (vol. xxxv of the 'Med.-Chir. Trans.') "that the bladder may be reached with the smallest amount of pain, with the least risk of present or future danger, and with the greatest prospect of ulterior good, by puncture through the rectum."

Puncture of bladder per rectum.

The records I possess of the cases of this operation positively prove the truth of this opinion, and it is gratifying to find that, in these days, many Surgeons recognise the value of the practice.

Its value.

The operation is as simple as it is safe, and as efficient as it is scientific. As a means of relieving a patient from the agony of retention of urine which has been proved to be irremediable by the *rational* use of catheters, it stands unrivalled. By its adoption all forcible catheterism with its dangers is avoided. Perineal section and its difficulties as a remedy for retention are done away with, and the operation for puncturing the bladder above the pubes may nearly be forgotten. Puncturing the bladder through the rectum embodies in itself all the advantages of these means without any of their evils; and on practical grounds commends itself for our adoption.

Conclusion.

I would add, therefore, as a final conclusion:—"That in all cases of retention of urine from stricture in which relief cannot be given by means of rational and not forcible catheterism, and in which the use of the warm bath and opium have failed, the operation of puncturing the bladder through the rectum should be performed."

On Puncture of the Bladder per Rectum.

On the operation of puncture of the bladder per rectum.

In all cases of retention of urine in which relief cannot be afforded by the introduction of a catheter, and the nature of the obstruction is not such as to require the operation of urethrotomy, puncturing the bladder through the rectum is the right operation to perform, as by it, relief can be given with rapidity, certainty, and safety.

In former times, the bladder used to be punctured with a full-sized trocar and canula from the perinæum, but such a clumsy operation is not now recognised among surgical proceedings, though with the aspirator the same proceeding has been often undertaken. At the present day, some Surgeons prefer tapping the bladder above the pubes, but in safety and efficiency the operation is not to be compared with that which I now recommend, for, in the words of its modern advocate, Mr. Cock, "The operation is safe, easy of accomplishment, and without danger as to its consequences. In cases of retention which resist ordinary treatment it is greatly to be preferred to the long-continued attempts at catheterism, which, whether successful or not, must be infinitely more injurious to the urinary organs than the simple and almost painless operation of tapping."

Cock's remarks.

"I consider," writes Cock, "that the benefit of the operation consists, not merely in the immediate relief given to the patient, but also in the opportunity which it affords, by the retention of the canula in the bladder through an indefinite period, of diverting the flow of urine from its ordinary channel, and thus giving quiet, freedom from pain, and the natural means of restoration to the maimed, irritable, or diseased urethra. I conceive also that the bladder might be tapped with advantage in cases of obstinate stricture, in which retention of urine does not actually exist."

Objections are theoretical.

These views, published by Mr. Cock in 1852, 'Med.-Chir. Trans.,' and 'Guy's Reports,' 1866, I cordially endorse. The practice of Guy's Hospital, to my knowledge, has only confirmed their accuracy, and, the more I see of the operation, the more I like it. The objections raised against it are theoretical and not practical, for abscesses between the bladder and rectum, persistent fistulous openings, injury to the seminal vesicles, and wounds of the peritoneum, do not commonly occur. They are said to have done so in exceptional instances, but such must, indeed, be very rare. Mr. Cock, in his large experience, has known but one bad result to follow the operation, and that was atrophy of the testicle, from which he infers that the vas deferens was wounded. At Guy's, from the carelessness of a house-Surgeon, a fatal peritonitis from the perforation of a coil of intestine once followed the operation, the puncture having been made too far back; but eliminating carelessness—a cause of half the errors in surgery—the operation is very safe.

Its great success.

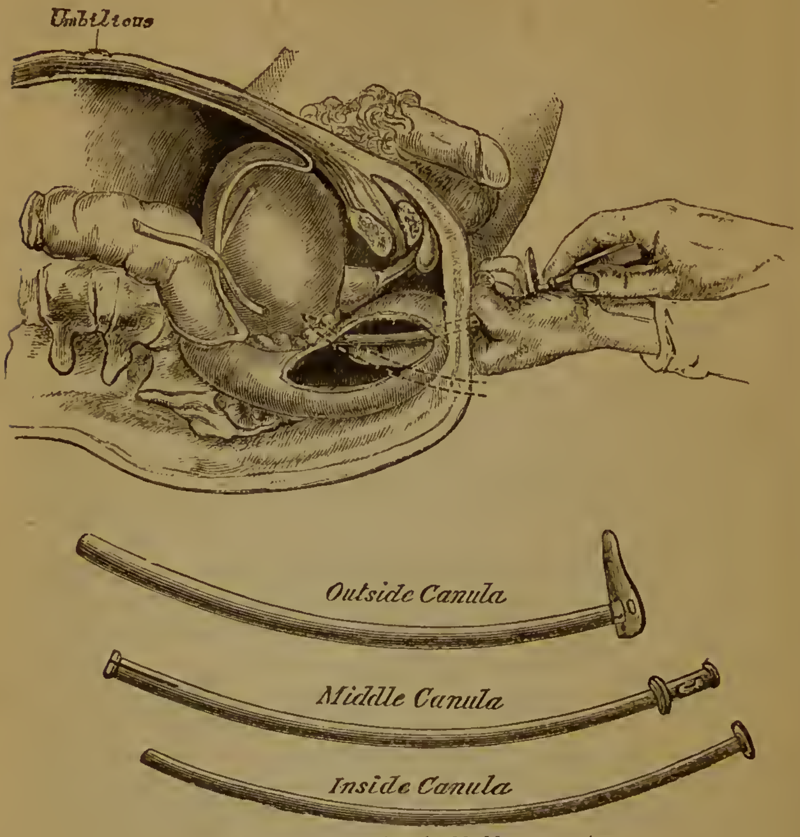
The only requisite is a moderately full bladder, a feature always present under the circumstances which call for the operation. An enlarged prostate is no real obstacle to its performance, since it may be perforated with impunity.

Mode of performance.

The Operation.—The best instruments are those suggested by Mr. Cock. The long curved trocar and canula, as originally employed, are inefficient instruments; indeed, many of the objections to the operation are, probably, traceable to their use. Cock's instruments consist of a canula, six and a half inches long, a blunt pilot trocar, and a sharp trocar; a second tube, with an expanding end to keep the canula in position; and a third to maintain the second in position (Fig. 368).

The patient should be placed and held in the position for lithotomy, and brought well to the edge of the bed. The operator must then introduce the index-finger of the left hand into the rectum with the palm upwards to feel for the prostate (Fig. 368), and, if possible, for the bulging base of the tense bladder beyond. Some little pressure above the pubes may help in this attempt. The pulpy point of the index-finger is then to be held in the median line just below the spot at which the puncture is to be made. The Surgeon then with his right hand is to take from his assistant the canula, well oiled and fitted with the *blunt* pilot trocar, and to introduce it into the rectum upon his left index-finger, passing it well up to the point selected for puncture. He should then steady the canula and hold it firmly in position with the thumb and three outer fingers of his left hand, and withdraw the blunt trocar. The *sharp* trocar can then be introduced through the canula, and, having reached its end, the handle with the canula is to be depressed and driven home, in a direction upwards and forwards, *in a line towards* *the umbilicus* (dotted line, Fig. 368). The bladder in this way will be entered, the free end of the instrument moving freely, and all resistance ceasing. The trocar should then be withdrawn, and the canula pressed well home. Before the bladder is completely emptied, it is well to insert the two inner canulæ, and fasten the whole in by means of tapes, two passed in front and two behind the thighs, to a girth round the waist. The canula may then be plugged with a peg to retain the urine, or with a hollow plug inserted into a piece of india-rubber tubing, through which the water may drain away.

FIG. 368.



Operation of puncturing the bladder per rectum.

As soon as the urethral passage has become pervious to the catheter, *but not before*, the canula should be withdrawn; this condition usually takes place within a week from the introduction of the catheter. In a case of mine the canula was left in for seven weeks before a catheter could be passed, when a rapid cure ensued. The stricture may then be treated on rational principles by dilatation. It is very remarkable how, at times, a stricture which has thus been left alone and unirritated by catheterism or ineffectual natural efforts at micturition, gives way under such treatment, and a thoroughly impervious indurated urethra becomes pervious and amenable to simple measures.

The wound into the bladder closes rapidly after the removal of the canula, even after many weeks; and, in a case of my own no urinary fistula followed the presence of the canula for seven weeks.

Sometimes required for enlarged prostate.

In retention of urine from enlarged prostate such an operation as this is rarely called for; yet at times it is necessary. It was performed at Guy's in two out of twenty-four cases of retention of urine from this cause and with complete success. I have had recourse to it on three occasions where the neck of the bladder and prostate gland had been seriously injured from rough catheterism, and with such good success that I shall never hesitate to repeat it when any difficulty exists in entering the bladder, or, in subsequently keeping an instrument in the bladder. In two of the cases mentioned, the irritability of the bladder was so great as to resent the presence of an instrument, and the pain and difficulty in its passage were so severe as to be nearly unendurable. In both the operation was followed by speedy and permanent relief; the bladder recovered its healthy condition after the parts had had rest for a few days, the urethra allowed of catheterism without distress, and convalescence was soon established.

I know of no operation attended with equal good, that is so safe, satisfactory, or free from danger. The Surgeon may perform it without fear in all cases of retention where any difficulty in catheterism exists.

Not to mistake suppression for retention of urine.

In all cases of supposed retention of urine, the Surgeon should guard himself against falling into the error of mistaking suppression for retention; as in all cases of supposed incontinence he should remember that it may be due to retention and overflow.

On Supra-Pubic Puncture of the Bladder.

Supra-pubic puncture of bladder. 'St. Barth. Hosp. Rep.,' 1881, p. 294.

This operation has been growing in favour and claims description. Mr. T. Smith asserts "that while it is as safe as the rectal puncture, it is easier of performance," and that "it is applicable to all cases of retention in which the bladder rises above the pubes."

In corpulent subjects and in such alone the skin should be punctured with a knife to facilitate the entrance of the trocar.

Whilst the urine is in full flow it is wise to introduce through the canula a gum elastic catheter with a terminal as well as lateral orifice. The former allowing the passage of a stillet into the bladder to serve as a guide for the introduction of a fresh instrument. The catheter should be firmly secured in position by means of threads attached to a belt of strapping, and plugged, and for permanent wear fitted with a soft rubber or vulcanite shield. Were I to perform this operation I should probably raise the bladder out of the pelvis by distending the rectum with the dilator as described at page 78, Fig. 325.

Extravasation of Urine in Children and Retention from Impacted Urethral Calculus.

Extravasation in children.

It has been already explained how retention and extravasation of urine in the *adult* may be produced by the mechanical obstruction of a urethral stricture. It remains to show how, in children, the same effects ensue from a mechanical obstruction of a very different kind. I allude to the obstruction caused by a urethral calculus.

Impacted urethral calculus.

A vesical calculus when small and ejected from the bladder may become lodged or impacted in any portion of the urethra, and as a consequence, give rise to every degree of difficulty of micturition, even to a retention of urine and extravasation. In adult life I have seen complete retention, but I have never seen extravasation occur as a result of impacted urethral calculus. In infancy and childhood, however, almost all the examples of extravasation of urine that have passed under my observation have been the product of such a cause; I have seen it in an infant fourteen months old, and in many others older. When a case of retention in a child comes under notice, and there is no phimosis, paraphimosis, or adherent prepuce by which this symptom may be produced, a strong probability exists that a urethral calculus is the cause.

Removal of calculus.

TREATMENT.—If the calculus can be removed by forceps carefully used, this practice is the right one to adopt; it is, however, rarely successful, and, where these means fail, the stone must be excised. When extravasation has taken place, the urethra must be opened in the perinæum by a free incision upon a grooved staff. The stone is sometimes lost in the sloughing tissues.

Summary as to the causes of retention.

By way of summary of the causes of retention it may be stated that retention in a *male child* is usually due to a urethral calculus, phimosis, paraphimosis, adherent prepuce, or the mechanical obstruction caused by a piece of string, &c. In a *female*, to ulceration about the meatus, or to adherent labia. Retention in the *young adult*, to stricture, obstruction of the urethra from stone, gonorrhœa, perineal, anal, prostatic abscess, or rectal disease. In the *aged*, from enlarged prostate or atony of the bladder.

Retention from fever or general nerve shocks may occur at all periods. In women, hysterical retention may also occur, as well as retention from uterine causes.

Urethral or Urinary "Shock" and "Fever."

Urinary shock.

Surgeons have long been familiar with the fact that certain male patients after the passage of a catheter experience symptoms which seem to be altogether irreconcilable with the simplicity of the operation that apparently excites them. They have known that immediately or soon after the easy passage of a catheter, and micturition, a man may shiver, turn pale and cold, or perhaps faint, turn sick, or vomit; that he may even have a slight epileptic convulsion and soon recover, the "shock" either passing off or being followed by a more or less severe febrile condition.

Mr. Banks and others have also pointed out how after the same simple exciting cause a man may suffer from "shock" of so severe a character as to terminate in death within twenty-four hours; or become the subject of a "continuous" or "intermittent" attack of fever which may or may not terminate in speedy death; the symptoms under these circumstances, assuming the shape of either uræmic or septicæmic poisoning; and in these cases when suppurative urethral or kidney disease in any of its forms is made out to exist, there is no difficulty in finding an explanation of the "shock" or of the "fever."

Renal disease as a cause.

Since the days of Richard Bright, and more particularly the publication of Dr. N. Chever's valuable paper on the causes of death after injuries and surgical operations ('Guy's Hosp. Reports,' 1843), Surgeons at Guy's have accepted as truisms "That an operation or injury in itself of a most trivial kind, is liable to be followed by fatal results, should the subject of it be suffering at the time from either acute congestion or granular degeneration of the kidneys;" "That it is impossible to urge too strongly the necessity of testing the urine for the presence of albumen in each patient, before deciding upon the performance of any surgical operation" however trivial it may appear; and that an operation upon the urinary organs of the simplest character must always be regarded as most dangerous when kidney trouble complicates the case; as well as when the patient has been long under the influence of tropical malaria, as pointed out by Sir J. Fayrer.

But this explanation of the symptoms cannot be given for all cases, and we must accept as true to a degree Sir A. Clark's recent assertion "that in persons apparently healthy, catheterism is sometimes followed by fever, neither distinctly uræmic nor distinctly pyæmic; that this fever sometimes ends in death, and that in such cases the autopsy reveals no definite visible structural lesion adequate to account for death."

'Edin. Med. Journ.,' April, 1884.

Under these circumstances we of necessity go to the nervous system as the one at fault, and recall the anatomical fact which "Müller long ago demonstrated, that the nervous supply of the penis, prostate, and neck of the bladder is almost purely sympathetic, the nerves being traceable to the pelvic or inferior hypogastric plexuses," and acknowledge that such plexuses are as susceptible to shock as are the abdominal.

Mr. Banks's paper, 'Edin. Med. Journ.,' 1871.

Other points also in urethral or bladder troubles favour this view; for instance, medical men must often have observed that with contraction of a distended bladder, on the expulsion of the last drops of urine, a shudder constantly passes through the healthy frame; and I well remember the case of a lady about thirty years of age, who had the severest rigor I ever witnessed as the direct and immediate effect of the bladder emptying itself after a long enforced retention.

Again, in a case of rapid lithotrity I had in 1883, in a man aged fifty-nine, from whom 200 grains of uric acid calculus were removed without difficulty or the slightest hitch in forty-five minutes, and where a good result was with confidence predicted, the patient in forty hours sank collapsed, the collapse not following the operation, but showing itself within the first twenty-four hours. After death perfectly healthy kidneys were found and an uninjured empty healthy bladder. In fact, no pathological cause of death was detected.

In all these cases "shock" was manifested, and shock without fever; the "shock" in its mildest form showing itself in the shudder of normal evacuation; in its more severe in the evacuation of retention; and in its most severe and fatal form in that following a somewhat prolonged though apparently not violent operation.

Conclusions.

I hold, therefore, that "urethral shock" as well as "urethral fever" are met with in certain patients, the subjects of urethral and bladder affections; and that probably both shock and fever are brought about through the influence of the sympathetic system.

That the shock may be only a passing shudder or faintness, but that occasional rare cases occur where the nervous shock is so profound, even after the simple introduction of a bougie or catheter, that death may result within twenty-four hours.

That urethral fever may assume any degree of intensity, from a slight rigor and subsequent general *malaise*, to such serious prostration as may end fatally after some days.

That a careful distinction must be made between true urethral fever and pyæmia resulting from operative interference with the urinary passages.

That renal disease, with its resulting vitiated condition of the blood, probably predisposes to death, as it unquestionably is one of its causes in such cases.

It will be seen that these conclusions coincide to a degree with those given by Mr. W. M. Banks in his able paper already referred to.

Treatment.

Treatment.—The Surgeon should ever have before him the possibility of a patient requiring the passage of a catheter being prone to suffer from urethral "shock" or "fever." He should, therefore, where possible, prepare him for the ordeal by clearing out the bowels and keeping him warm and quiet for twenty-four hours, and, in many cases, in bed. Where any malarious fever has previously existed, a good dose of quinine—say five grains—should be given a few hours beforehand, and even when no such history can be obtained, a like practice has advantages. Should the patient have any external appearances of renal disease, and albumen be found in his urine, the surgeon should not pass a catheter without these precautions, unless under the pressure of urgency.

Under all circumstances, the catheter must be clean, warm, and well anointed with some antiseptic oil. It must be used carefully and tenderly. Should the bladder be much distended, part of the urine should be drawn off at the time, and the remainder at a later period; and if the contents of the bladder are fœtid, and the organ requires to be washed out, some little of the injected antiseptic fluid should be left behind in the bladder. When a soft instrument can be used it should be preferred. When "shock" is caused by the manipulation, the warmth of a bed with some external appliance to the extremities, and the administration of a wineglassful of hot spirit and water acts often well.

When slight febrile disturbance takes place, a dose of Dover's powder, or the bromide of potassium is very useful.

In more chronic cases quinine and iron, combined or separately, are of great value, as also are vapour or hot-air baths. When the symptoms are continuous or recurring, renal disease is to be suspected, and the treatment must be conducted under such a light. The prognosis of these cases always turns upon the persistency or frequent recurrence of the symptoms and the elevation of the temperature, together with the indications afforded by the daily careful examination of the urine.

CHAPTER XXIV.

AFFECTIONS OF THE GENITAL ORGANS.

There is probably no part of the body which varies more in its conformation than the penis, or one in which any congenital defect is more likely to be inherited. The elongated and contracted prepuce is particularly hereditary, and all the male branches of a family may be the subjects of it. I have known this to be the case in many instances, and in one family five sons suffered from it, as well as their father.

Phimosis

Phimosis, or a condition of prepuce which, either from narrowness of the preputial orifice, or adhesion, cannot be retracted behind the glans, is, sometimes, a *congenital* affection, but as often as not it is an *acquired* one—the result of inflammatory thickening and contraction subsequent to a preputial chancre, or other trouble.

So long as the prepuce is only long, and the glans can be uncovered for purposes of cleanliness and during erection, operative interference is not called for, though it is well to impress upon nurses the necessity of paying attention to the infant's penis, and of cleaning it daily, since a want of such attention is frequently the source of urinary trouble and penile irritation. From neglect the secretion of Tyson's glands collects behind the corona, and acts as an irritant; the prepuce and glans penis as a result constantly become adherent, and as a consequence of the irritation, bladder symptoms, simulating those of stone, appear (*vide* page 67). In some neglected cases an acute inflammation is induced, followed by œdema of the prepuce and the secretion of pus, which suspicious minds have too often interpreted as gonorrhœa, much to the injury of nursemaids and others in whose charge the child rested. This disease is essentially a balanitis, and is easily cured by cleanliness. In the adult, a long and narrow prepuce is injurious, as being a bar to proper cleanliness, and interfering with coitus, or rendering it painful. It is also without doubt an exciting cause of cancer of the organ, where a disposition to such an affection exists. In boyhood it may, by exciting an irritation in the parts, induce a habit which ends in masturbation. It often gives rise, moreover, to incontinence, and may produce retention of urine. Dr. Lewis Sayre, of New York, has also pointed out, in his work on 'Orthopedic Surgery,' 1876, that, as a direct result of this condition of the prepuce, talipes, paralysis, and other nervous affections may take place, the talipes being due to muscular contraction of the lower extremities, owing to reflex nerve irritation; and paralysis as a consequence of nervous exhaustion caused by the undue genital excitement which is often associated with this condition.

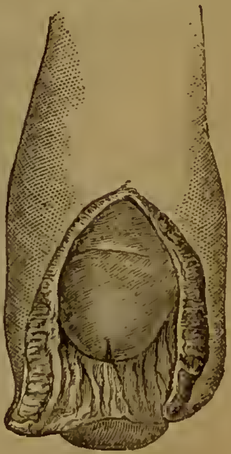
Inflammatory phimosis.

Treatment.

Treatment.—When the narrowing is not great the daily retraction of the prepuce over the glans for purposes of cleanliness is generally sufficient to dilate the orifice, care being taken to replace it subsequently. Dr. Cruise's plan of dilating the orifice mechanically is not satisfactory; I have given it a trial, and rejected it. The suggestion also of making two partial lateral sections of the mucous membrane has in my hands met with the same fate. Neither of these methods is so successsful as to warrant its being recommended.

When phimosis exists, congenital or otherwise, it is, as a rule, best treated by circumcision. In exceptional cases where a narrowing of the prepuce is more marked than an elongation, the prepuce may be slit up (Fig. 369), but in children circumcision is the better operation. In some instances, however, where the penis is very short, the fault resting more in the penis itself than its skin covering, circumcision should not be performed, for I have known, under these circumstances, the operation to fail, even when well done; in such cases the prepuce should rather

Fig. 369.



Operation for phimosis.

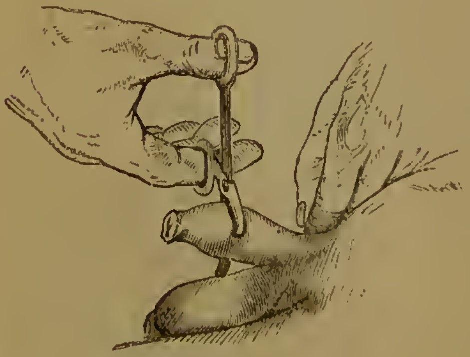
be slit up to the corona, and its mucous covering turned well back and fixed to the skin.

Slitting plan. In minor cases the *slitting* plan should be carried out; the skin and its mucous lining being divided in the middle line, either by the introduction of a bistoury guided by a director beneath the prepuce, or by means of a pair of sharp scissors. The Surgeon must be careful in doing this, to divide the mucous membrane *right back to the corona.* In the adult he should then turn the two flaps backwards, and fasten the mucous to the skin flap by means of some fine carbolised catgut sutures. In the infant there is no necessity to stitch. When the prepuce requires division to expose a sore or some warty growth, the above plan should be elected.

Circumcision. Circumcision is an operation that requires great nicety, for it fails if sufficient skin is not taken away, and the mucous covering of the glans is not fully divided up to the corona, and it does not turn out well when too much skin is removed. It is by no means a dangerous operation, although in "bleeders" it may be so, Grandidier ('Die Hämophile,' 1855), recording seven cases of Jewish children who died from preputial hæmorrhage after circumcision. The following is the plan I have for years adopted and taught, and have never known to fail if properly carried out:

Mode of operating. The first point is to decide how much skin is to be removed, which can satisfactorily be determined by applying a pair of long dressing forceps to the skin of the penis, whilst it rests in the natural position, on a level with the corona, and closing them as soon as the glans penis has been allowed to slip backward. The integument in front of the forceps may then be amputated with a scalpel (Fig. 370).

Fig. 370.



Operation for phimosis (first step).

The forceps should now be taken away, and the mucous covering of the glans be divided in the middle line, well up to the corona (as in the slitting operation), and turned backwards, the two flaps being stitched to the skin by fine sutures. In adults, a fine uninterrupted suture is probably the best; in infants, a strip of dry lint wrapped round the parts is all that is necessary.

The glans penis in this as in the former operation should be completely separated from its mucous covering, all secretions removed, and the frænum divided when short.

By adopting these suggestions the student has a definite guide to aid him in the removal of the skin; whereas if the end of the foreskin be drawn out, as usually recommended, he has none.

"Circumcision is practised amongst the Tongans (Friendly Islands), not as a religious rite, but principally because the women won't have the men who are *un*circumcised, and they have to remain unmarried" (J. E. Moulton, 'Wesleyan Missionary,' February 26th, 1880).

Paraphimosis.

Paraphimosis is said to exist when a tight prepuce which has been retracted behind the glans cannot be replaced, and as a consequence a strangulation of the glans and mucous lining of the prepuce with œdema takes place, and at a later period ulceration in the line of strangulation, and even sloughing.

In children, it follows the accidental retraction of a narrow prepuce, and in adults, the mechanical retraction of the prepuce during coitus, and the neglect to reduce it. It may be associated or not with some venereal complication.

Treatment.

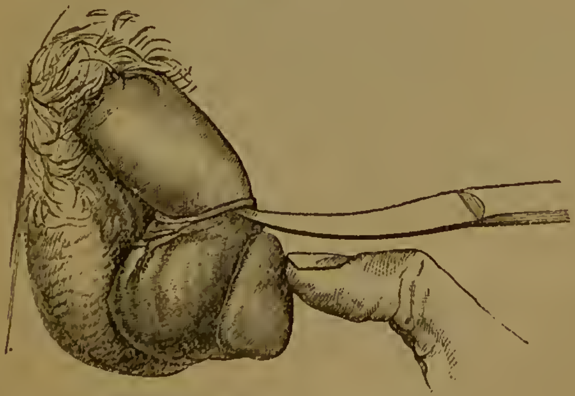
TREATMENT.—The object of the Surgeon should be to reduce the glans behind the narrow prepuce by which it is strangulated, and, failing this by simple means, he must divide the constricting preputial orifice so as to effect this end.

Mode of reduction.

Division of stricture.

To carry out the first object an india-rubber band applied as an Esmarch's bandage will sometimes answer, but if not, an anæsthetic should be given and the patient placed on his back, the Surgeon should take the penis between the index and the middle fingers of his two interlocked hands, and while thus pulling the prepuce forwards forcibly press the glans backwards with his two thumbs, the pressure of the thumbs and counter-pressure with traction of the interlocked fingers so displacing the fluid from the œdematous tissues as to allow of the reduction of the paraphimosis. When the œdema is very great, a few needle or lancet punctures facilitates the operation. When the affection has been of some days' standing and ulceration exists, and, when failure has followed all attempts at reduction, the strictured preputial orifice must be divided; but the band must not be looked for directly behind the glans, but behind the roll of œdematous prepuce that surrounds it. This is best done by a cut, half an inch long, made with a scalpel in a vertical direction over the constriction, the thumb of the left hand forcibly depressing the glans penis (Fig. 371). The prepuce at times yields audibly and the wound gapes; the whole constricting medium should be divided. Some antiseptic lotion should be applied to the parts subsequently to assist recovery. After the

FIG. 371.



Mode of dividing prepuce in paraphimosis.

paraphimosis has been reduced and the œdema subsided, it is wise in the case of children to circumcise, and in the adult the same practice is frequently desirable. In all cases of *œdema of the penis* in children, the Surgeon must remember that it may be due to mechanical strangulation.

Warty growths.

Warty growths are very common on the penis, and they may be found fringing the orifice of the prepuce and the urethra, or growing from any part of the mucous membrane between these two points; indeed, they may grow from within the urethra, as well as from the outside skin of the prepuce. They have, in the bulk of cases, a venereal origin, that is, they have been caught by contagion, for warts are contagious; but they, at times, occur without any such cause in men who have long prepuces, and who are not sufficiently careful in local cleanliness. When they are numerous, their excision is the only successful treatment, nitrate of silver being applied to their bases, but in less severe examples, the dry oxide of zinc, freshly powdered savine and calomel, are good local application, the warts rapidly withering under their influence.

Treatment.

Cancer of the Penis.

Cancer of penis.

In the middle-aged and old, it is sometimes difficult, if not impossible, to distinguish simple warty from cancerous growths; although the greater obstinacy of the cancerous and their disposition to bleed are probably the best points of distinction.

When there is ulceration the disease is probably cancer. If the cancer be left to take its course, the glans penis and prepuce become infiltrated and the ulcer discharges a fetid ichorous secretion, breaks down, and spreads; the inguinal glands become involved, and death takes place from exhaustion. At times the whole organ is destroyed and the scrotum involved.

Cancer of the penis is generally of the epithelial variety, true carcinoma being comparatively rare.

Treatment.

TREATMENT.—In all clear cases of this disease, unless the inguinal or lumbar glands are extensively involved, amputation is the only sound practice to follow, and, in the doubtful, it is the wisest. When the prepuce alone is involved, the excision of the growth may be sufficient, but nothing less than amputation is of any use when the glans is affected. Under all circumstances, the Surgeon should cut quite free of the disease, for the tissues about it are probably more or less infiltrated with cancerous products. I have a patient alive and well now (1884), whose penis I cut off for cancer seventeen years ago, and a second, from whom I excised a cancerous mass from the prepuce sixteen years ago.

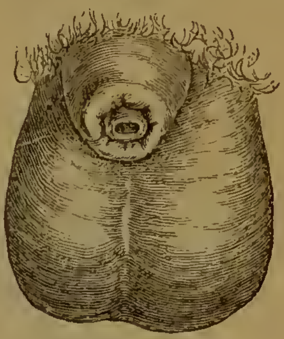
Amputation of the Penis.

Removal by galvanic cautery.

Since the galvanic cautery has been in use, I have employed nothing else for amputation of the penis. A gum elastic catheter should be introduced into the urethra, and the platinum wire passed with a needle between the spongy and cavernous bodies, and then round the penis and made tight with the écraseur screw. Connection with the battery must then be made, and the wire screwed *slowly* home, for, if the tissues are divided too rapidly, hæmorrhage will take place. The heat should not be too intense. The wire should then be made to divide in the same way the spongy body and the urethra, half an inch or more nearer the glans penis. Under ordinary circumstances, the operation is absolutely bloodless, and the subsequent pain slight. After the penis has been removed, it is wise to slit the urethra open for about half an inch, turn its two edges outwards, and fasten them to the skin with sutures. This step is good to prevent the contraction of the urethral orifice that may otherwise ensue. When the cautery is not to be had, the knife should be used. The old operation consisted in the removal of the organ by one clean sweep of the bistoury, an assistant having steadied and compressed the base of the organ by a band of tape. The modern improved operation, which, I believe, was suggested by Hilton, consists in the introduction of a narrow bistoury between the spongy and cavernous bodies, and after dividing the latter, the spongy body with the urethra must be cut through about half an inch more forward. The object of this is to make the urethra stand out from the stunted organ, and thus facilitate micturition. It is without doubt the best mode of amputating a penis with the knife. To prevent any tendency in the urethra to contract, it may be slit open or stitched back to the preputial skin. Fig. 372 illustrates the stump after such an amputation.

Amputation of penis with bistoury.

FIG. 372.



Stump of penis after operation.

To arrest hæmorrage during the operation, Clover's clamp for compressing the penis is very excellent, and ought to supersede the tape.

Other Tumours of the Prepuce.

The prepuce may be the seat of *fatty, sebaceous*, or even *fibrous* tumours, though these are rare. It is not uncommonly the subject of what has been described as *elephantiasis*, although when the penis is involved the scrotum is usually similarly affected. I have, however, seen one case in a man, aged thirty-five, where the penis was thus alone affected. The organ was immense, and frightful to look at. When in repose, it measured eight inches round and six long. The man came to me with a gonorrhœa, admitting, however, that he had never been able to have true coitus since the disease had existed, which was about four or five years.

Tumour of the prepuce.

Hypertrophy of prepuce.

The disease is a chronic hypertrophy of the skin and cellular tissues. Nothing but the excision of the redundant integument is beneficial.

Injuries to Penis.

These are not common, excepting such minor injuries as laceration of the frænum or prepuce, produced in coitus. Incised wounds, however, are occasionally met with, the products of insanity, jealousy, or malice; the parts require careful adaptation with sutures. Recently I had a man under care who was lifted off a bench by a woman holding his penis. The accident was followed by much urethral bleeding, which was stopped by ice, and a good recovery took place. The body of the penis at times, however, becomes the seat of injury from some rough bending of the organ during connection or otherwise; and, as a consequence, when the immediate effects of the injury have passed away, strange symptoms appear. Thus, some years ago I was consulted by a gentle-

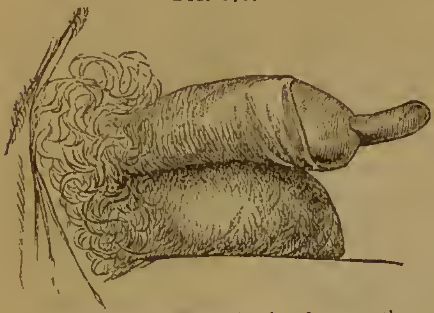
Injuries to penis.

man, whose penis, when turgid, arched laterally, the cavernous body of one side having atrophied, and become a mere gristly mass. This condition had followed an injury received in coitus many years before. Some great induration had existed for months in the cavernous body that had subsequently atrophied.

More recently, I have seen a married man, about 60, who a year before "missed his mark" in coitus, and hurt his penis; an induration followed, and at the present time where this existed there is a deficiency of tissue, and when the penis becomes turgid it is never straight, but bent laterally. A singular case of injury to the penis was seen at Guy's in 1867, in the practice of Mr. Hilton. It was in a man, æt. 50, who, when nineteen, had had his penis bitten by a stallion; after the accident some little bleeding occurred, and a fleshy cylindrical body, an inch and a quarter long and one third of an inch in diameter, projected from the urethral orifice. It was evidently the corpus spongiosum, which had been divided by the horse behind the glans penis, and had become everted. When the patient was admitted the corpus spongiosum urethræ terminated abruptly about one inch behind the glans penis, and the urine flowed by the side of the protrusion (Fig. 373).

An unusual case.

FIG. 373.



Corpus spongiosum projecting from urethra after injury.

Malformation of the Urino-genital Organs.

Malformations.

Varieties.

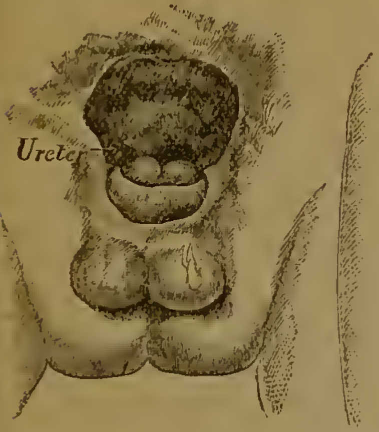
These malformations of the urino-genital organs are more common in the male than in the female subject, and show themselves in many degrees of severity. Thus, when the upper surface of the urinary passage from the orifice of the urethra to the fundus of the bladder is deficient, a case of *extroversion of the bladder* or *ectopion vesicæ* is said to exist; when the urethra alone is deficient at its upper part, *epispadias* is the term employed. Some authors apply the latter also to the more complete condition. With this imperfect condition, a separation of the pubic bones frequently exists, as well as some malformation of the scrotum, this sac being often bifid, though containing the testicles in proper position. At times a hernia complicates the case. When no testes are present, and the scrotum is bifid, the question as to sex often arises, for in the female the vagina is frequently absent, or so small as more nearly to represent a urethra than a vagina.

Extroversion of bladder or epispadias.

In extroversion of the bladder the posterior wall of the bladder appears as a red mucous mass below the umbilicus, which is lost in the upper border of the deformity. At the lower part of its surface the orifices of the ureters may be often seen as small nipple-like projections; and in some instances these orifices are lost in the pelvic chink, although they may be brought into view by depressing the fissured penis or what represents the penis, for this will probably appear only as an expanded glans penis and a pendulous prepuce. The cleft urethra, as it becomes lost in the pelvic fissure, can be made visible by pulling the parts down. (Fig. 374).

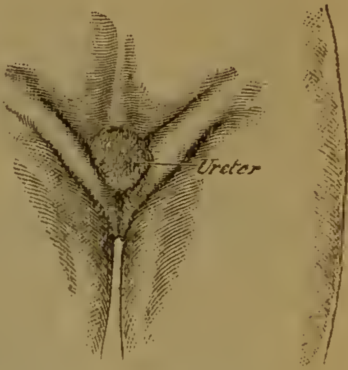
In the female subject, the exposed urethra will be seen between the two labia. When the vagina is present, it will open at its upper border, and appear continuous with the lower labia. (Fig. 375). At times, though very rarely, the epispadias involves only the urethra. I have seen but a few cases of this peculiarity, and in all the exposed mucous surface of the urethra passed backwards towards the pubes into a fissure, which was covered in by a thin transverse fold of skin, from beneath which, urine flowed. The scrotum was large but bifid, and contained the testes ('Guy's Hosp. Rep.,' 1868).

Fig. 374.



Ectopion vesicæ in male,

Fig. 375.



in female.

Treatment.—The chief annoyance connected with this deformity being due to the constant dribbling of the urine, Messrs. Simon and Lloyd were induced to carry out an ingenious operation by which the urine might be carried into the rectum and the fissure subsequently closed, but the attempt failed and has not been repeated. For particulars the reader may refer to the 'Lancet' (1851 and 1852). Holmes has suggested a modification of Simon's plan, and it is probably in this direction that some good may eventually be found. Treatment.

In a case of epispadias, in a boy, recently under my care (Sept., 1875), in which the whole of the urethra down to the neck of the bladder was fissured, and in which consequently there was incontinence of urine, I tapped the urethra in the perinæum in front of the prostate, and established an artificial urethral opening. By these means the urine passed through the perinæum instead of above the pubes, and consequently could be caught and retained in a urinal, greatly to the patient's comfort. In another case, one of a boy æt. 7, I, in May, 1880, after making a perineal incision, drew down the penis, brought it out of the perineal wound, and fixed it there. Subsequently I completely closed the original fissure below the pubes. The case did well, and all the urine flowed through the perinæum, and was readily caught in a urinal. Case.

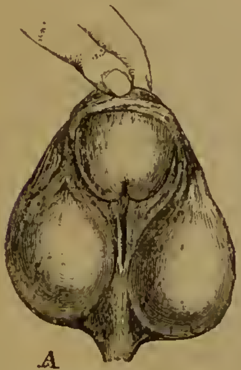
Other Surgeons, however, have devised means by which the exposed mucous covering of the bladder may be covered in, thereby adding to the comfort of the patient; and of these Wood, of King's College, has been the most successful. He has operated in ten such cases, and Holmes in five. I have operated only in two. Four of Wood's succeeded completely; three of Holmes's; and one of mine, the others being partially successful. The operation consists in bringing up flaps of skin from either side of the fissure and covering it in, fastening them together by sutures. For full details, *vide* 'Med.-Chir. Trans.,' vol. lii, and Holmes's 'Surg. Dis. of Child.,' 1868. In one case I destroyed the mucous membrane with the cautery, and thus turned it into a cicatrix, avoiding the ureters.

Hypospadias.

Hypospadias is a term applied to any deficiency of the under surface of the urethra, and in the larger number of cases, the urethral orifice is placed below the glans at a spot corresponding to the preputial frænum. In some, a depression exists in the glans penis corresponding to the natural outlet with several small depressions between the urethral orifice and the cup-like depression at the extremity of the glans; while in others, one or more foramina are present, situated below the true opening of the urethra through which urine escapes. The urethral opening in these cases is often small and requires enlarging.

In more extreme cases the urethral orifice appears at the base of the penis, when the deformity is commonly associated with a bifid scrotum; under these circumstances, when the testes are absent, the question of sex is raised. In a case of this kind which I saw in 1867, the sexual passion was so strong that a man came to me to ask for castration, as he was unable to copulate on account of the stunted condition of his penis, and the way in which it was held down by a band which caused it to arch downwards under excitement. The man at the time had testitis from ungratified passion.

FIG. 376



Perineo-scrotal hypospadias.

Treatment.

The operative measures that have been employed for the relief of this deformity have hitherto not been very successful, although recently ('Med. Times and Gaz.,' Jan. 30, 1175), Mr. John Wood has recorded two cases of the *balanic* or *penile* varieties in which relief was given, and M. Duplay has published full details of his method of dealing with the more advanced form of malformation, called the perineo-scrotal (Paris, 1874), Fig. 376, A. I think so well of Duplay's operation that I will describe it. It has for its object, *first*, to separate the penis from the scrotum and destroy its arching, in order to allow erection and coition; and, *secondly*, to construct a new urethra from the abnormal perineal opening to the glans penis.

To carry out the first indication, a free division of the fibrous bands connecting the penis with the scrotum has to be made; and when this can be effected by a subcutaneous wound as adopted by Bouisson, so much the better. Duplay, however, incises transversely the tissues from without inwards, dividing, if necessary, the envelopes and septum of the corpora cavernosa; this incision leaves a lozenge-shaped wound (Fig. 376, B), the edges of which may be brought together by sutures (Fig. 376, C). After this operation, the penis is to be kept constantly stretched to guard against subsequent retraction, and six months later the second part of the operation should be carried out.

The construction of a new urethra is a difficult matter, and must be carried out in stages.

Duplay's operation.

Duplay's method is divided into three.—1st, the restoration of the urinary meatus; 2nd, the creation of the new urethra from the meatus down to the hypospadic perineal opening; and 3rd, the reunion of the two portions of the urethra.

The *first stage* may be done at the same time as the correction of the arching of the penis, and consists in simply paring the edges of the glans penis, and bringing them together by sutures round a catheter (Fig. 376, C). It is almost always successful.

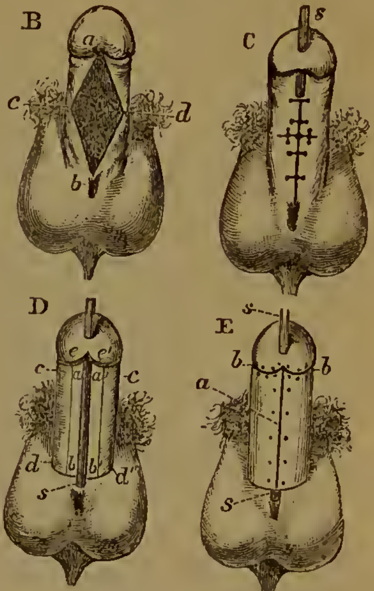
The *second stage* is to be effected in the following manner:

The penis being held up, two longitudinal incisions are made on its inferior surface parallel to the median line, and extending from the glans penis to the perineal urethral opening, these incisions being bounded by two transverse ones (Fig. 376, D). Two quadrilateral flaps are thus formed (*a b, a′ b′*), which should be large enough when turned back to cover a catheter that has been previously introduced into the urethra.

The cutaneous surface of these flaps should next be turned towards the catheter, and the raw surface exposed to view.

The skin of the penis, in continuation of the transverse incisions, is then by a little dissection made to furnish two new flaps (*c d, c′ d′*) for covering the raw exposed surface of the first flaps.

FIG. 376.



Operations for perineo-scrotal hypospadias.

Lastly, the lower edge of the glans penis is vivified in the part which corresponds to the new channel.

The flaps must now be united, their superior edges being stitched to the vivified glans and the two flaps on each side of the urethra, the superficial and deep brought together with metallic or other sutures (Fig. 376, E).

The *third* stage of the operation consists in the reunion of the two portions of urethra, and should be effected by paring the edges of the hypospadic orifice, and bringing them together by sutures deep and superficial.

After the operation the urine must be drawn off by means of a catheter, and the union of the parts is usually completed after three or four days. To render this result more certain the membranous portion of the urethra might be opened in the perinæum, as in cystotomy or median lithotomy, and a catheter introduced into the bladder to divert the urine from the seat of operation during the healing process.

Puberty is the best period probably for the performance of this operation.

Occlusion of the urethra from some membrane or band sometimes exists, which if not broken down in intra-uterine life leads to dilatation of the bladder, sacculation of the ureters, distension of the pelvis of the kidney, and destruction of its secreting structure (*vide* cases by Morris, 'Med.-Chir. Trans.,' 1876).

ON LOCAL VENEREAL DISEASE.

Gonorrhœa.

Causes.

Urethritis, gonorrhœa, or clap, are terms applied to cases of inflammation of the urethra of every degree of intensity, and the product of a great variety of causes. In some the affection is the consequence of the direct irritation of an instrument passed into or left in the urethra, while in others, it follows excessive or ordinary sexual intercourse with unchaste or chaste women who are out of health, and suffering from acridity of the vaginal secretion. "A leucorrhœa," writes Diday, "which would have remained inoffensive after a single coitus, takes on, by redoubled excitement, irritant properties, and furnishes then a contagious fluid" (gonorrhœa). It is the direct product most commonly of contagion from the pus of an inflamed mucous membrane, Simon ('Holmes's System,' vol. i) having shown that "there is ample room to question the popular impression that only specific inflammatious are communicable; much reason for suspecting it, on the contrary, to be a generic and essential property of inflammation, that its actions are always in their kind, to some extent, contagious, pus from an acute inflammation producing its kind on inoculation."

Lee's views.

Lee states ('Holmes's System,' vol. iii, ed. 3) the causes of urethritis to be the application of a gonorrhœal discharge to the sexual organs, and also certain irritating substances applied to the mucous membranes, such as menstrual fluid, leucorrhœal discharges, and the injection of a solution of ammonia; he does not exclude constitutional cause, such as gout or rheumatism.

Cases resembling.

It is well to bear in mind also Ricord's observation, "that gonorrhœa often arises from intercourse with women who themselves have not the disease;" and Diday's, "that from the very fact of a woman having a discharge, no matter what its origin, she is liable to give a discharge to a man. Complaints closely resembling gonorrhœa sometimes appear in persons the subjects of stricture, after sexual intercourse, a debauch, or other excitement.

May be acute or chronic.

The disease may be *acute,* and come on within a few hours of connection, or it may fail to show itself for five or ten days, and, in a general way, the sooner the symptoms appear after the contagion the acuter the disease. It may be *subacute* or *chronic.*

Symptoms.

Acute or inflammatory stage.

It generally commences by an itching about the orifice of the urethra, the mucous membrane of which will probably appear swollen and injected; there will be the sensation of heat on micturition, and, after the lapse of a few hours, some muco-purulent fluid will be squeezed out of the urethra. In acute diseases, the urethral discharge will soon become abundant, and yellow, green, or blood-stained pus will flow from a highly-injected and swollen urethra; the whole glans and penis will become red, swollen, and painful; micturition will also probably be difficult, painful, and scalding, the passage being obstructed by the swelling of

Chronic.

the mucous membrane. Chordee, or painful erections, as the disease advances will appear, and later on perineal pain, if not suppuration. The groins, testicles, and perineum, too, become the seat of more or less tenderness; and constitutional symptoms show themselves, varying with the degree of the inflammatory action; in some subjects the febrile condition is well marked, but in most it is absent. After the lapse of ten or fourteen days these acute symptoms partially subside, the discharge becomes thinner and more muco-purulent, the external signs of inflammation less marked, the pain on micturition less severe; the perineal, inguinal, or scrotal pain probably will have disappeared, and a thin muco-purulent urethral discharge, with a slight sensation of heat on micturition, alone remaining.

Gleet.

When these symptoms are allowed unchecked to run their course they will gradually pass into the condition known as that of *gleet,* in which a thin muco-purulent urethral discharge exists, unattended by any local or general source of pain. *Gleet,* however, may be the result of some stricture or local urethral disease, such as an ulcer.

Seat of disease.

The ordinary seat of the affection is the mucous membrane of the urethra, the orifices of the lacunæ being chiefly involved. The fossa navicularis and parts around, and the mucous membrane of the bulb, are the most common seats; the dissections of Sir A. Cooper, Ricord, Thompson, and others, having proved this. At times, however, gonorrhœal inflammation may, as Wallace pointed out ('On Venereal Disease'), involve at the same time the whole of the urethra, the bladder, the testicles, the glans, and the prepuce, in the male; and in the female, the nymphæ, clitoris, vagina, &c., the disease, as it creeps along to the posterior part of the urinary passage, decreasing in intensity in the anterior. In severe cases the inflammation may extend to the submucous tissue, and run on to thickening, and even to suppuration.

Urethritis, the result of some mechanical irritation of the urethra, is rarely acute; it, as a rule, subsides as soon as the cause has been removed. Urethritis, the consequence of some gonorrhœal contagion, is almost always acute, and having once been started is not readily arrested.

Gleet, whether the consequence of an acute or subacute inflammation, when of some standing, is almost always due to some urethral contraction or stricture.

Gonorrhœa in the female.

In the female, gonorrhœa is to be recognised as a yellow purulent vaginal discharge accompanied by heat, pain, and signs of acute inflammation. The less purulent it is, and the more the discharge is made up of mucus and epithelium scales, the greater is the probability of the disease being due to vaginal irritation other than gonorrhœal, that is, to leucorrhœa; and, when the discharge is made up of masses of glutinous, semi-transparent, albuminoid material like the white of egg, the more certain is it that the discharge is uterine and comes from the glands in the neck of the uterus.

It must be remembered, however, that in both sexes, as long as any purulent or semi-purulent fluid is poured out by the mucous membrane of the genital passage (even the slightest gleet), violent urethritis, or inflammation of the vagina, may arise in another subject by contagion, and there is good reason to believe that sexual excitement is an important element in aiding the propagation by contagion. Mr. J. Morgan, of Dublin, believes that the vaginal discharges of constitutionally infected women are the cause of the majority of sores in men.

Treatment.

TREATMENT.—Gonorrhœa or urethritis is a local disease and may be treated locally with success. When it is the result of local irritation from the passage of an instrument, no treatment is called for, the discharge ceasing naturally as soon as its cause has been removed, but when from gonorrhœal contagion, such a result is not met with.

Salines.

In a very acute clap, when the urethra and penis are swollen from vascular turgescence, free purgation with salines is the best practice, and, in plethoric patients, the addition of antimony in quarter-grain doses to excite nausea is most valuable.

Copaiba.

Sandal wood.

In less severe cases, copaiba may be given in doses of twenty drops or half a drachm three times a day with advantage, but this drug should not be continued for more than three days. If it is to do good it will show its influence within that time, and a longer continuance of the drug is useless and deleterious. The yellow oil of sandal wood may also be employed in the same dose and under like circumstances, and at times, it acts most beneficially even when the copaiba has failed, but it is in no way certain in its action.

Strong injections condemned.

For cleansing purposes an injection containing three or four drops of Condy's fluid to the ounce of water is to be advocated. It may be used in all stages of the disease. Astringent injections are always of value when they can be used frequently and efficiently, but strong injections are to be condemned. They may cure the disease suddenly, but more commonly they fail, and set up inflammation of the bladder and other mischief, by adding to the irritation.

The best injection in all stages of the disease is tannin in the proportion of three to six grains to the ounce, and next to this is alum in the proportion of two or three grains to the ounce, or the chloride of zinc, one grain to the ounce. A solution of salicylic acid is also good, half a drachm of the acid being dissolved in six ounces of water with a scruple of borax. The perchloride of mercury, one grain to six ounces of distilled water, as an occasional injection, has been recently advised. To be of use injections should be used from four to six times in the twenty-four hours. An ordinary glass syringe will answer every purpose if the glans penis be well held, but there are special syringes which are supposed to have some advantages. During this treatment, the use of such alkalies as the citrate or tartrate of potash in twenty-grain doses, or ten grains of the bicarbonate may be given, and good food allowed, but little or no stimulant.

In chronic stage.

In the chronic stage, I have found great benefit from the introduction into the urethra of a large catheter covered with the glycerine of tannic acid; and, at times, the Suppositorium Acidi Tannici rolled into sticks and passed into the urethra acts most beneficially.

The best way to give copaiba is as a bolus mixed with calcined magnesia, and wrapped in wafer paper, or, as a mixture with gum and peppermint water. The capsules are uncertain in their action. Copaiba is well known to produce in some patients a severe rose urticarious eruption. Cubebs are less to be relied on than copaiba.

On injections.

In using injections, the object is to make an impression upon the mucous membrane by their astringent effects, and to keep it up. Weak astringents frequently employed are far more valuable than strong ones used at longer intervals. When so used they are as beneficial in gonorrhœal inflammations of the urethra as in that of the eye. When a man can devote himself to the cure of his clap, and throw into his urethra a weak astringent every hour, he will often check it within two or three days, in the same way as a gonorrhœal inflammation of the eye may be controlled under similar treatment. The nitrate of silver injection is an uncertain, and, at times, a dangerous remedy, adding often to the disease instead of diminishing it. In all cases of long-continued clap or gleet in the male, the presence of a stricture should be suspected. It may often be made out by the passage of a full-sized *bougie à boule*, when an ordinary catheter fails to detect it. The gleet should only be satisfactorily treated by the cure of the stricture, that is, its full dilatation. **Bougie.**

Tonics, particularly iron, are valuable adjuncts to the treatment. **Tonics.**

All connection must be forbidden for some time after the apparent cure of a clap, for any sexual excitement is likely to be followed by a relapse. Drinking and smoking to excess are injurious.

In women, a clap is readily cured by the frequent use of astringent injections of tannin, alum, or sulphate of zinc, ℥ss to a pint; the passage into the upper part of the vagina of the tannic acid suppository is also excellent treatment. In the use of both these means the patient should lie down with her hips raised, and the astringent should be allowed to remain in the passage. To inject it sitting or standing is a useless, although too common a practice. **Treatment in the female.**

Complications.—In male subjects, inflammation of the *epididymis* is the most common complication, the disease, doubtless, spreading in a direct way from the urethra through the vas deferens and cord to the epididymis. In some cases it stops at the cord; in others, it goes on to affect the testicle itself. It is often associated with hydrocele, and from this fact some Surgeons have been led to believe that inflammation of the testicle itself is a common consequence of a clap. **Complications.** **Epididymitis.**

The treatment of this affection will be considered in a future page.

In the female, inflammation of the *ovary* is said to occur, and even *pelvic peritonitis.*

Abscesses in the cellular tissue external to the urethra, penile or perineal, are often met with in acute gonorrhœa, and should be opened early. **Abscess.**

Chordee, or painful erection caused by the stretching of the corpora cavernosa, into which inflammatory products have been infiltrated, is a common consequence, and a very painful one. Full doses of opium (gr. j), or ten grains of henbane, and a like dose of camphor, are reliable remedies. Ricord used a suppository of ten grains of camphor and one grain of the extract of opium; I have sometimes thought the morphia suppository the most useful. Belladonna also smeared over the urethra gives relief at times. **Chordee.**

Retention of urine may likewise occur from the mechanical closure of the urethra through its swelling, from spasm of the urethra, or from both causes. The warm bath and opium are the best remedies for the complication, a catheter being passed only when an absolute necessity exists. **Retention of urine.**

Inflammation of the prostate is likewise a complication, as is also *inflammation of the bladder.* (*Vide* Chapter XXI.) **Inflammation of prostrate.**

Sympathetic bubo.

Inflammation of the inguinal glands or sympathetic bubo is often present, the glands occupying the upper part of the groin being usually involved, but those below Poupart's ligament are not seldom affected. In neglected cases these glands may suppurate. Fomentations and tonics are the necessary treatment. The absorbents of the penis are at times inflamed and suppurate.

Balanitis.

Balanitis.—When the glans penis and prepuce are involved in the inflammation, and this inflammation is attended with profuse discharge, *balanitis* or *external gonorrhœa* is said to be present. This affection may be due to want of cleanliness as much as to gonorrhœal contact. When the prepuce becomes œdematous, and is long, *phimosis* takes place; when narrow and retracted behind the glands, so as to be irreducible, *paraphimosis* exists.

This balanitis should be treated locally by astringents, such as the acetate of lead or the nitrate of silver lotion, v—vj grs. to the ounce, painted on the inflamed part. Phimosis and paraphimosis should be treated on principles already stated.

May be syphilitic.

It should be remembered, too, that a balanitis associated with a rawness or erosion of the glans or prepuce may be due to a syphilitic inoculation.

Warts.

As a consequence of balanitis *warts* are very common, and may cover the mucous membrane of the glans and prepuce, or invade the urethra itself. They may grow to a great size, putting on much the appearance of a cancerous penis. I have seen them perforate the prepuce of a penis when phimosis was present.

Treatment of warts.

They can only be treated by removal. When extensive, their excision is the best plan, the operation being performed with the patient anæsthetised, the nitrate of silver or perchloride of iron, or the galvanic cautery, being freely applied to the base of the warty growths. In less severe cases, the warts will often wither if kept dry with the oxide of zinc or the fresh powder of savin.

All warts are not, however, gonorrhœal; some may arise without any such cause, even in clean subjects. They are, nevertheless, contagious. In women, they are often found up the vagina, but more frequently at its orifice.

Gonorrhœal Rheumatism.

Gonorrhœal rheumatism. Generally in chronic stage of gonorrhœa. Parts liable to be attacked.

An affection so called is an undoubted complication of the disease, explain it as we may. At the end of an attack of clap patients without doubt are often attacked with severe pain and tenderness of one or more joints, attended with effusion and constitutional disturbance. It may occur with every fresh attack of clap, and I have recorded a case in my book on the joints, in which it recurred sixteen times after sixteen different attacks of gonorrhœa. Some authors look upon this affection as a species of pyæmia, due to the absorption of some morbid matter from the inflamed urethra, but evidence is still wanting to prove the truth of the theory. It rarely appears during the acute stage of the affection, mostly in the chronic, but arrest of the discharge cannot be associated with its appearance. The knees and ankles are the joints mostly involved, yet those of the upper extremities are so at times. The fair-haired and what are called strumous subjects are said to be more prone to the disease, but I cannot say I have observed this. At times the rheumatic pains are more confined to the tendons, fasciæ and muscles; the heels and soles of the feet are also frequent seats; as a result of this inflammation the parts involved, and particularly the fasciæ, may soften and yield. The late Dr. Babington used to say that this form of fascial rheumatism was found only in those who had taken copaiba.

Acute case.

Symptoms of arthritis.

The disease may be "*acute*," "*subacute*," or "*chronic*," and when acute it may run on rapidly to suppuration. The most acute example of suppuration of a knee-joint I have seen was of this nature: it occurred in a man, æt. 35, during the acute stage of gonorrhœa. It was treated by free incisions into the joint, and followed by a good recovery with a stiff joint. This may well be called acute *gonorrhœal synovitis*, to distinguish it from an acute *gonorrhœal arthritis*, upon which my friend and colleague Mr. Davies-Colley has written an able paper ('Guy's Hosp. Rep.,' vol. xli, 1883, p. 187). Gonorrhœal arthritis "is as often found in the female as the male—perhaps more often. It usually begins before the gonorrhœa or discharge has existed for any considerable time, and the subjects are generally under the middle age. The onset is like that of an attack of acute rheumatism. The patient is feverish, and has pain, tenderness, and swelling of several joints. These symptoms are often so severe that he has to take to his bed. In a few days the inflammation leaves all the joints save one, in which it concentrates itself with great severity. This may be any one of the larger joints. Most frequently I have seen it in the elbow. The appearance of the joint is not at all like that which is seen in acute synovitis. There may be effusion within the synovial sac, but the most striking characteristic is the œdema of the soft parts round the joint, accompanied, as a rule, during the height of the attack, by redness of the skin. The swelling is in some cases very great, and when the elbow has been affected I have seen the redness and œdema extending from the shoulder to the wrist-joint. I believe that the superficial effusion is due to the inflammation having attacked especially the fibrous tissues of the capsule rather than the synovial membrane by which it is lined. The slight amount of effusion which occurs in the synovial sac is probably secondary to the affection of the adjacent fibrous tissues, just as we sometimes see an acute periostitis near the end of the diaphysis of a long bone accompanied by some effusion into the neighbouring articulation. The joint is very tender, hot, and full of pain, and any attempt to move it gives rise to excruciating pangs. The general temperature of the body is but little elevated." From the great œdema which accompanies this affection it may be mistaken for phlegmonous erysipelas, phlebitis, or lymphangitis; but a little care should prevent an error in diagnosis from being made. Mr. Davies-Colley has pointed out that it may be associated with cardiac complications.

Treatment.

TREATMENT.—Medicines seem to have but little influence on this disease. Local treatment is, however, very necessary, such as immobility of the affected joint, with warm fomentations, with or without the decoction of poppy-heads. The extract of belladonna or opium diluted with vaseline is at times a valuable application. Opiates to relieve pain are essential.

Should the joint suppurate it must be dealt with by free incisions. In the arthritic form this result is rare. When the acute symptoms have subsided pressure is of great value.

Under all circumstances the urethral or vaginal discharge must be cured. Passive movement of the joint must be resorted to as soon as swelling and heat have gone, but many joints become permanently stiff after this affection.

Messrs. Duplay and Brun, who have written on the subject ('Archives Générales de Médecine,' 1881), advocate the use of plaster of paris splints.

Herpes Preputialis.

Herpes preputialis.

This is a simple affection, which may be mistaken for chancre, and is known by the appearance of a crop of vesicles around the corona of the glans, or upon the external or internal surface of the prepuce. It is generally attended by much local irritation and local evidence of inflammation, the vesicles when they burst often discharging freely. The affection runs its course in a few days, and then the parts heal. A zinc lotion of three or four grains to the ounce, or a solution of nitrate of silver gr. v to the ounce, expedites recovery.

The number of vesicles and their grouping is generally sufficient to enable the Surgeon to diagnose this affection from a venereal disease.

Chancre

On chancre. Definition.

may be defined as a sore the result of venereal contact, and in a general way it is found upon the penis of the male and genitals of the female, but it may be seen upon other parts of the body, such as the pubes, thighs, lips, tongue, nipples, fingers, &c. &c. in fact wherever the secretion from an infected subject may be applied to a raw surface.

Generally local.

In by far the larger number of cases, this disease begins and ends as a local affection; in a smaller number it is a local inoculation of a constitutional disease, and is followed by syphilis. The sore is not syphilis, although it is the direct means of communicating syphilis, any more than the inoculation of smallpox is smallpox, although the inoculation may be the means of giving smallpox.

When local is usually unimportant.

So long as the chancre is a local affection alone it is comparatively unimportant, however extensive and troublesome it may be in healing. But whenever it is the local inoculation of a constitutional affection such as syphilis, it is of grave importance, however apparently trivial may be the local sore.

Is a sore a local or constitutional one? Early diagnosis difficult.

It becomes, therefore, a vital question to make out from the appearances and conditions of the sore, whether it is likely to prove a local disease only, or to be followed by constitutional symptoms, and to a certain extent this diagnosis may be made; that is, a Surgeon may from the external appearance of a chancre go so far as to say that in all probability, *this* one will not be followed by syphilis and *that* one will; but he can do no more; to dogmatise upon the point and to speak with certainty is beyond his power.

The soft and the hard sore

The chancre which will not in all probability be followed by syphilis is the *soft suppurating sore*. The chancre that will in all probability be followed by syphilis is the *hard non-suppurating sore*.

Hunter's chancre.

John Hunter thus described the indurated chancre:—"The sore is somewhat of a circular form, excavated, without granulations, with matter adhering to the surface, and with a thickened edge and base. The hardness and thickening are very circumscribed, not diffusing themselves gradually and imperceptibly into the surrounding parts, but terminating abruptly." In this description we read type of the hard infecting chancre, the chancre of the inoculation of syphilis wherever found. Hunter adds, however, that "a chancre has commonly a thickened base; and, although the common inflammation spreads much further, yet the specific inflammation is confined to this base." An infecting chancre may, too, appear only as a crack, excoriation, or indurated tubercle, without abrasion.

Hard chancre not generally attended with a suppurating bubo.

This form of chancre is commonly associated with some induration, not suppuration, of the first row of the inguinal glands, the *multiple indolent bubo.* Its secretion consists of epithelial débris, of globules of lymph more or less perfectly formed or disintegrating, and of serum, *not pus,* and not auto-inoculable. In debilitated and unhealthy subjects, adds Lee, infecting sores will suppurate as any non-specific lesion would do, and in such cases, it is sometimes very difficult to distinguish the secretion produced by the local disease from that which depends upon constitutional peculiarity.

Soft chancre.

The *soft suppurating chancre* is often multiple, has an excavated surface with neatly shaped and cut edges as if the wound had been punched out. It has an irregular and worm-eaten surface secreting abundance of pus. It is prone to spread rapidly and to become phagedænic. It has usually a soft base, but if otherwise, it will have what Ricord has described a phlegmonous hardness, and not a defined one, as is the syphilitic chancre. It is commonly associated with a suppurating bubo, and secretes pus, which "has the property of always reproducing its specific action when applied to another part of the same body, or when inoculated upon another person."—*H. Lee.*

Generally with a suppurating bubo.

Lee's observations.

The experiments of Fournier and Rollet, and Lee's observations, led the latter Surgeon to "conclude that if a venereal sore yields a secretion capable of being inoculated so as to produce the specific pustule, the evidence, so far as it goes, is in favour of its being a local disease, and of its not requiring constitutional treatment. If, on the contrary a disease which we believe to be primary syphilis yields a secretion which is not auto-inoculable, then the evidence is against the local character of the affection and indicates a constitutional mode of treatment." In this we read the type of the simple local venereal sore.

In a clinical point of view, however, this great distinction between the two forms of chancre is not always definable; and consequently an intermediate class of cases in which syphilis occurs has to be recognised, approaching in their clinical features more the soft sore.

The three forms of syphilitic sore.

There are, therefore, three forms of syphilitic sore, which the Government Committee on Syphilis has thus well described:—

One characterised by induration throughout its entire course;

One, soft in its early stage, and becoming subsequently indurated; and one soft throughout the whole course, but which, unlike the simple local sore, is followed by constitutional disease.

Hard sores do not of necessity give rise to syphilis, whilst soft sores may. And it is an undoubted fact, that the question of induration or non-induration is greatly determined by the position of the sore; chancres on the female genitals, simple or syphilitic, and chancres on the glans penis being rarely hard.

Conclusion.

The point, therefore, resolves itself into this—that the indurated chancre with a fair amount of probability, although not certainty, may be the precursor of syphilis, and not a merely local disease. The soft or non-indurated sore, in exceptional cases, may be due to a syphilitic inoculation, although in the majority of cases, it is a purely local affection.

Fringing sores.

A crop of soft sores fringing the prepuce, or surrounding the corona, is, in all probability, a simple and non-syphilitic disease.

Spreading chancre.

A spreading chancre with a suppurating bubo is probably a local affection.

A small single chancre indurated from the beginning is the most suspicious of syphilis, although even in this there is no certainty of its being so. In fact, it is not possible to speak with any certainty as to a chancre being syphilitic or otherwise. Syphilis is a constitutional disease which can only be recognised by its constitutional symptoms, and not by the point of its inoculation.

Period of incubation.

With respect to the *period of incubation* of a simple or syphilitic chancre, no definite time can be given, since it varies from a few hours to a week; but the multiple suppurating simple chancres, as a rule, appear more rapidly after infection than any other; the syphilitic chancre often does not appear for a week at least, sometimes two or three, after infection. Dr. Bumstead, of New York, says—"that an interval of at least ten days will be found to have existed between infection and the appearance of the sore." (Edition of 'Cullerier's Atlas of Venereal Disease,' 1868.)

Varieties in appearance of the chancre.

A chancre, like any ordinary sore, may present different appearances at different times. It may be at its origin vesicular, papular, pustular, or an excoriation, and pass through the *ulcerating*, *granulating*, and *cicatrising* stages; in one case the ulcerating stage will be a long one, while in another it may be so brief as hardly to be recognised.

The action of the sore may vary with the condition of the patient, as well as with the condition of the part upon which it is placed, and it will be influenced probably by the nature or stage of the infecting sore from which the disease has been communicated.

May assume different conditions.

A chancre, like an ordinary sore, when there is much local action and little constitutional power, may become irritable, inflamed, or phagedænic, more particularly when drink, irregular living, and debauchery have so enervated the system as to render the patient unable to withstand the effects of any local irritation. These various actions may attack the chancre at any period of its progress.

When sloughing.

When a chancre is sloughing or phagedænic from the first, and has originated from an inoculation of syphilitic matter, there is every reason to believe that the sloughing process may have a beneficial tendency, since the very intensity of the local effects of the poison may be the means of preventing its absorption, and thus, also the outbreak of syphilis. When, however, the sloughing action appears during the ulcerating or later period of the chancre's progress, it will have no such useful influence; for when syphilis is inoculated through a chancre, it is during its vesicular, papular, or pustular condition, prior to its ulcerative stage, and no action of the sore that appears after this period can have any effect in checking the diffusion of the poison. "If the inflammation spreads fast," writes Hunter, "it shows a constitution more than naturally disposed to inflammation: if the pain is great it shows a great disposition to irritation; it also sometimes happens that they very early begin to form sloughs. When this is the case they have a strong tendency to mortification." "These three conditions of a sore," adds Aston Key, commenting upon the above, "distinct in their cause and in their operation from the syphilitic action, are adverted to, as pointing out the distinction that is to be drawn between the irritable, inflamed, and the sloughing chancre; and afford a guide to the pathological Surgeon as safe and as intelligible as the more elaborate descriptions of modern writers." ('Guy's Hosp. Rep.,' 1840.)

Treatment of Chancre.

On treatment of chancre.

The uncertainty that most Surgeons entertain as to the nature of a chancre, from the knowledge that any sore upon the penis ranging from a simple excoriation to an indurated chancre may be the inoculation of syphilis, renders it desirable and expedient that all sores should be destroyed at the very earliest period, and when this is effectually done before the ulcerative stage has set in, or during the vesicular, papular, or pustular stages, there is good reason to believe that constitutional syphilis may often be prevented.

Immediate destruction.

When, however, the sore exists as an ulcer, this abortive practice is useless, indeed, in the majority of cases, it makes a small sore large, retards recovery, and in no way prevents syphilitic symptoms appearing if the chancre had had a syphilitic origin. But, taking all together, not one chancre out of four has a syphilitic origin.

When ulceration has taken place.

For the destruction of a chancre on its first appearance, nitrate of silver, nitric acid, potassa fusa, or chloride of zinc, may be applied, so that the base of the sore is well destroyed.

Means of destroying chancre.

When this is not done, the chancre should be treated on ordinary principles; to the inflamed sore, lead lotion, with or without opium, may be applied; to the sloughing sore, opium with tonics, internally, are indicated; to the indolent sore, nitric acid lotion or black wash are the best stimulants; while to ordinary sores iodoform should be used.

Ordinary principles of treatment.

A chancre requires no special treatment, beyond its primary destruction from motives of expediency, or with the hope of preventing constitutional infection. The common practice of applying black wash to all sores on the penis is not needed; and to cauterise all chancres at every stage of their existence as soon as they come under notice is unnecessary. When the powers of the patient are feeble, tonics are called for, and any special conditions are to be treated on common principles.

In early stage no special treatment.

Medicines useful for syphilis should only be given when other evidence of syphilis exists beyond that afforded by the local inoculation. To treat all chancres alike, as if due to syphilis, is uncalled for and unscientific; by doing so many patients are materially injured.

Complications of Chancre.

Complications of chancre.

Phimosis.

Phimosis is one of the most common complications, and is found in at least a fourth of all forms of chancre and at all stages of their progress. It is probably most frequent with the sloughing sore. In the fringing preputial chancres, however, it is a common complication. It is an accidental accompaniment of a chancre, and is due to the inflammatory infiltration of the prepuce. When not severe, it is not a condition of much importance, if local cleanliness be attended to, for as the chancres heal, the inflammatory œdema will subside and the parts will assume their natural condition.

When to be slit up.

When, however, *œdema is present*, and a blood-stained discharge mixed with the débris of broken-up tissues escapes from beneath the prepuce, and doubt consequently is felt as to the nature, position, and character of the chancre; when evidence exists that the parts beneath are undergoing a destructive process which demands direct local treatment, the prepuce must be slit up, the Surgeon taking care to do this effectually; since through a want of due attention to this point the glans penis may be destroyed or the prepuce perforated. When the sore has been exposed it ought to be treated on ordinary principles. When a simple purulent discharge comes from the orifice of the prepuce, the constant use of water and simple lead or other injection will probably suffice. Phimosis without inflammatory œdema rarely calls for treatment.

Phagedæna.

Phagedæna.

Venereal like other sores may slough, the suppurating chancre being more prone to take on this action than the non-suppurating and indurated. When a sore sloughs from the first, it will probably prove to be non-infecting, and, even if syphilitic in its origin, it may lose its syphilitic nature, the sore, when the sloughing action has ceased, becoming a simple one. This action is at times so intense that the penis rapidly swells, inflames, and becomes gangrenous after infection, the whole organ at times sloughing off; while at others the action will be more partial.

Varies in intensity.

May be of dry kind.

In exceptional instances the mortification is of the dry kind. In the Peninsular War, when the British troops were in Portugal, this sloughing of the penis from inflammation was so severe that Inspector Fergusson ('Med.-Chir. Trans.,' vol. iv) wrote :—"It is probable more men have sustained the most melancholy of all mutilations during the four years at war in Portugal through this disease, which was called the 'black lion,' than the registers of all the hospitals in England could produce in the last century." He attributed the severity of this affection to the free sexual intercourse of persons of different nations.

Causes.

How far this phagedæna depends upon some peculiar power of the infecting poison, or upon the constitution of the individual patient is difficult to determine, although the latter probably has the greater influence, since when any such depressing agency as that caused by drink, excess of venery, or illness is present, phagedæna is more likely to occur than under other circumstances.

Treatment of phagedæna.

TREATMENT.—In the treatment of all cases of phagedæna, opium, tonics, and good living are the three essentials; while mercury and the iodide of potassium are inadmissible.

Locally, the part must be kept clean by frequent ablution, and to this end, the prepuce often requires to be slit up. Lotions of nitric acid, one drachm to five ounces of water; of carbolic acid, one part to thirty; of sulphate of copper, five or ten grains to the ounce; of potassio-tartrate of iron, from ten to twenty grains to the ounce, are also useful, and opium in solution is often a good addition. When the disease spreads, local mercurial fumigation is said to be of value; but change of air is most beneficial.

Bubo.

Adenopathy or bubo is a common complication of the simple as well as of the infecting chancre; that is, it is found in the local venereal sore as well as in the inoculation of true syphilis, but in the former the gland as a rule suppurates, while in the latter it rarely does so, at any rate as a consequence of the local sore.

Lee's views.

"Lymphatic absorption," writes Lee, "from a suppurating syphilitic sore (simple) necessarily produces a suppurating bubo; any attempt to prevent such an affection from suppurating is entirely futile. The disease within the lymphatic system is the same, and runs a similar course as that upon the surface of the body."

In simple sores.

The bubo associated with the simple non-infecting sore is the direct result of the absorption of the specific pus, the matter in the interior of the gland retaining its specific characters, whilst that outside the gland is ordinary non-specific pus. As the disease advances, however, the two fluids mix, and the whole acquires the characters of the specific fluid, the surface of the sore about the glands becoming in this way inoculated.

In infecting chancres.

In the infecting and syphilitic chancre the enlargement of the glands is usually indolent, and unconnected with suppuration. It appears within the first or second week of the inoculation, and many glands are usually involved, forming hard, indolent, painless swellings. In exceptional cases, however, where the sore is a source of local irritation, suppuration of the glands may take place—the suppurating bubo, in the course of the constitutional symptoms, being no rare event. The presence or absence of suppuration in the inguinal glands is not, therefore, evidence of any positive value as to the existence or non-existence of a syphilitic affection. It may, however, be stated that a local sore on the penis associated with an adenopathy, which passes rapidly on to suppuration, is in all probability a local and not a syphilitic affection, while a local sore with a simple induration of the glands is in all probability a syphilitic inoculation.

Diagnostic value of bubo.

Simple adenitis.

In every form, therefore, of chancre, though more frequently in the local sore, simple adenitis or sympathetic bubo may be met with as a result of local irritation, which differs in no respect from the adenitis of any other local organ. One or more glands may be involved in the action, and suppuration may be acute, subacute, or chronic. In the simple local sore it is usually acute. As a rule, too, the sore formed by the venereal bubo, unlike that resulting from simple adenitis, instead of healing kindly, often takes on very much the appearance of the local disease; the edges ulcerate, the opening enlarges, and a large sore is formed; indeed, from this action, the *serpiginous* sore, to which allusion will be made, often takes its origin. At times the bubo puts on a phagedænic action, and spreads fearfully.

May ulcerate.

Bubo *d'emblée.*

In rare cases, the glands are said to enlarge without any local lesion, this chronic enlargement being followed by syphilis. I have, however, never seen a marked instance of this, and in reputed cases have suspected the former existence of some overlooked local sore or fissure. Mr. Cock does not recognise the affection.

Treatment of bubo.

TREATMENT.—There is nothing to be gained by suppuration of the inguinal glands, for even when associated with syphilis the poison is not eliminated by such means, and when due to some simple local source of irritation is only an additional cause of annoyance.

To endeavour to prevent suppuration is, consequently, a wise course, which can best be done by rest and the local application of cold in the form of ice, or lotions of lead, muriate of ammonia, or spirit. When suppuration is threatening or cannot be retarded, warm fomentations are the best, and as soon as pus has formed a free incision should be made, followed by warm-water dressing or a poultice. A vertical incision, as a rule, is the best; but when the abscess is large the opening should be made in the long axis. The application of leeches or iodine to a bubo that threatens to suppurate seems a useless practice.

Incision.

In the indolent bubo, or rather where indurated glands exist, local treatment is useless; though care should be observed that no local source of irritation is added to that of the sore, and no excess of exercise taken by which the inflammation may be increased.

When the cellular tissue around the glands is infiltrated with inflammatory products as indicated by its brawniness, &c., the value of local pressure by means of a pad and the spica bandage (Fig. 278, vol. i, p. 758) is unquestioned; while tonics, rest, and other constitutional treatment are beneficial. The local application of some mercurial ointment at times appears to be of use, and a small blister, a strong solution of iodine or of nitrate of silver, is of value in hastening either the absorption of the inflammatory products or their suppuration. As soon as suppuration appears, the abscess should be opened. When a hard gland is left at the bottom of a suppurating wound the American practice of applying such a caustic as the potassa fusa to its centre, to cause its death and subsequent sloughing, or Golding-Bird's electrolytic caustic, occasionally is of great use, this practice being as useful in syphilitic glandular enlargements as in others. In some instances the removal of the gland by the scalpel may be expedient. Sinuses must, if possible, always be laid open.

Pressure.

Local application.

Sinuses to be laid open.

If phagedæna attacks a bubo, the local application of nitric acid or the actual or galvanic cautery is sometimes called for, more particularly when, in spite of general or other local treatment, it spreads. Opium, tonics, and other internal remedies, must not be omitted.

HYDROCELE OF THE CORD AND OF THE TESTICLE.

Definition.

Hydrocele, or a collection of serous fluid in close connection with the testicle or spermatic cord, is a term which has been applied to two classes of cases which differ in their progress as well as in their pathology, and agree only in the one marked and prominent symptom to which the term hydrocele is applicable. For clinical purposes, however, the word has certain advantages, and, with this view, may still be employed.

Varieties.

Accepting the term, therefore, as signifying a collection of fluid in close contact with the testicle or spermatic cord, two great divisions of the subject at once suggest themselves, namely, the "*vaginal hydrocele*" or the collection of fluid into some portion of the tunica vaginalis, either of the cord or testicle, and the "*encysted hydrocele*" or spermatocele, which is an expanded and newly-formed cyst, as a rule, in connection with the epididymis, and but rarely with the body of the testis.

On the formation of serous sac.

On the Formation of the Serous Sac.—It is well known to all who have studied physiology that the testicle in its descent from the

Hypothesis of anatomical conditions.

loin during fœtal life draws with it into the scrotum two layers of peritoneum with its attendant nerves and vessels, and that all pass through the internal and external abdominal rings in front of the cord into the scrotum, the posterior layer of peritoneum being in close connection with the fibrous capsule of the body of the testicle—the tunica albuginea—and the anterior in connection with the purse or scrotum. In a perfectly normal condition, it is generally supposed that at birth, or shortly after, the two surfaces of this serous membrane close and become adherent, the canal which was at one time present ceasing to exist from the internal abdominal ring to the upper portion of the testicle; while in the scrotum the two serous surfaces remain permanently free for the purpose of allowing easy and ready mobility of the testicle in its scrotal covering. It is now, however, well known that the prolongation of the serous membrane down the inguinal canal *into the scrotal sac* often remains patent for a longer period than has generally been supposed, and that in some cases it continues as a pervious canal during the whole of life It is likewise known that *the vaginal process* of the peritoneum may be closed at the upper part of the testicle, but remain open above, during childhood, and even up to old age; also that this naturally formed peritoneal tube and sac may be closed at the internal or external abdominal rings, or at any intermediate spot between these points, or at its junction with the testis.

Anatomical facts in respect to vaginal process of peritoneum.

As a consequence of these facts, it is tolerably clear that a collection of serous fluid may take place in any part of this prolonged serous channel, and that a hydrocele of the cord or testis of different kinds may be produced.

Congenital hydrocele.

We thus find during infant and early life, from a want of closure of this tube at the internal ring, that a serous exudation may take place either into the cord alone or through the cord into the scrotal portion of this peritoneal sac. Under the former circumstances, a *congenital hydrocele of the cord*, and under the latter, a *congenital hydrocele of the testicle*, is said to exist. When the tubular portion of the canal is closed at the junction of the cord and testicle, and the testicular part is open, a *simple vaginal hydrocele* exists; and, when the tubular portion of the canal is only closed at the internal ring, the hydrocele may extend more or less up the canal, even as far as the internal ring.

Congenital hydrocele of cord.

Diffused and encysted hydrocele of cord.

In another class of cases the serous fluid may be confined between the internal and external rings, giving rise to the so-called *diffused hydrocele of the cord*; and, when it occupies a still more restricted space, it is usually described as an *encysted hydrocele of the same part.*

The pathology of all these different conditions remains, however, the same; the different position of the fluid being accidentally determined by the extent and lines of adhesion, or the closure of the peritoneal testicular prolongations. A congenital hydrocele may be complicated with a hernia. A reference to Figs. 261-2-3, given to illustrate the subject of hernia, p. 732, vol. i, will assist the student in understanding these points.

The Pathology of Hydrocele.

Pathology of acquired hydrocele.

It may with considerable confidence be asserted that, as a general rule, the secretion of the serous fluid which gives rise to the ordinary vaginal hydrocele is due to an inflammatory affection of the tunica vaginalis, because in certain cases flocculi of pure lymph may be seen floating in the secretion, while in others spontaneous coagulation of the same may be observed. The thickening of the tunica vaginalis, moreover, which so frequently takes place in chronic cases, the presence of membranous bands and septa in the cavity of the serous sac, and the fact that this form of hydrocele may be produced by extension of the inflammatory action from the epididymis or the body of the testicle, point likewise to the same conclusion.

Of congenital.

It is not, however, so clear that an inflammatory action has any influence in the production of the serous effusion in the congenital form of hydrocele, in which a communication still exists between the abdominal peritoneal cavity and the scrotal serous sac; indeed, it would rather appear as if the exudation was of a passive nature and merely an excess of the natural secretion of the serous membrane, since in many of these cases the fluid rapidly disappears under tonic treatment, being reabsorbed as the powers of the patient improve, and *vice versâ*.

Fluid of hydrocele.

The fluid of a vaginal hydrocele is invariably albuminous, and under the influence of an inflammatory action this is markedly increased; hence, the amount of albumen in the fluid of a hydrocele is determined by the nature and violence of the inflammatory action. In the congenital variety it is a thin, serous, and saline fluid of a clear colour, slightly tenacious and albuminous, the fluid differing in no single point from the natural serous fluid of the peritoneal cavity. In the acquired form it may present the same characters, but it is usually more tenacious and varies from a pale amber to a deep straw colour. In some examples the fluid will be stained with blood, in others it will hold cholesterine in suspension, at times being perfectly opaque and syrupy from the presence of such matters. It is, however, in the old and chronic cases alone that these last conditions are to be observed.

In acute cases.

In chronic cases.

In the *acute vaginal hydrocele* more or less fibrin will be found either in solution or in the form of false membrane or adhesions between the two surfaces of the serous membrane; and, in *the chronic*, the walls of the cyst will be found to have undergone great changes; the thin clear membrane having become thick and opaque, owing to the organisation of the inflammatory product which had been poured out into its tissue, and in certain cases containing cartilaginous or ossific deposits, while on its surface it will present a firm fibrous appearance. In rare cases suppuration may occur in the tunica vaginalis, and even prove fatal. Thus, in 1883 a male child, æt. 8 days, was brought to Guy's with a red, swollen, glistening scrotum, and the report that it had not passed urine for hours. The penis and perinæum were healthy. A catheter was passed without difficulty and a few drachms of urine drawn off, but the child died next day. After death the urinary organs were found to be healthy, but the tunica vaginalis on both sides was full of pus, and as the vaginal process of the peritoneum on both sides was open and communicated with the peritoneal cavity, there was evidence of peritonitis by extension.

Suppuration of hydrocele.

Uncomplicated hydrocele, or a simple effusion into the tunica vaginalis, unassociated with any disease of the testis or epididymis, is generally a painless and insidious affection; it attracts attention mainly by its size, and demands treatment chiefly from the mechanical inconvenience it causes. It is generally of slow progress, and, as a rule, will be found to have existed for many months before seen by the Surgeon, the patient seeking advice only when the organ has become cumbersome, and from its weight has excited some pain and dragging in the lumbar region.

The Clinical Examination of a Hydrocele of Testicle.

Diagnosis or mode of examination.

On examining a testicle the seat of this disease, the enlargement will be found free and readily movable, and to occupy the position of that organ which it includes. On inquiring into the history of the case, it will be ascertained that the swelling appeared primarily in connection with the testis, and gradually encroached upon the upper portion of the scrotum towards the external ring. On the Surgeon grasping the neck of the tumour below the external ring he will at once feel the cord clear and distinct above the tumour. In exceptional cases, however, the fluid will be found to pass upwards through the external as far as the internal ring, and in such examples the peritoneal testicular process has closed only at one point, and that is at its internal abdominal opening (Fig. 261). On taking the tumour in the hand it will be found to be light, and on passing the fingers over its surface it will be felt smooth and uniform. Fluctuation will also readily be detected on the slightest and most delicate palpation. The position of the testicle should then be looked for and made out; its natural site being somewhat posterior, and in large tumours, towards the upper part. But it must be borne in mind that in certain examples, that is, in cases in which the organ is malplaced, the testicle may be in front of or below the tumour. The best test of its presence is afforded by manipulation; the peculiar testicular pain felt on the application of pressure affording a certain indication. The question of translucency should next demand attention, for when present it is of peculiar importance, and indicative of the vaginal hydrocele. It must be remembered, however, that such a symptom is not constant, since it is neither present in cases of hydrocele in which the fluid is thick, bloody, or opaque, nor when the walls of the vaginal tumour have become thickened by fibrinous deposit.

Position of testicle.

Translucency.

It should be added that, for this translucency to be well observed, the integuments of the scrotum should be firmly stretched over the scrotal enlargement.

Shape, &c.

The tumour is generally described as being of a regular and pyriform shape, but this condition is very variable, since the shape of the swelling depends upon the openness of the tubular peritoneal membrane of the cord and the connection which exists between the surfaces of the tunica vaginalis testis and tunica vaginalis scroti. When the canal has closed and withered down to the body of the testis the swelling will be more or less globular; and the higher the point of closure of the vaginal peritoneal sac towards the internal ring, the more pyramidal will the watery swelling necessarily become. If adhesions exist between the two layers of serous membrane at the lower portion of the testis, the hydrocele will appear to be at the upper part; and, when the natural contraction between the tunica vaginalis of the cord and of the testicle is not completed (Fig. 263), an irregular or even hourglass contraction may make its appearance—the outline of a hydrocele depending much upon the anatomical conditions of the part in which it is situated, and the pathological changes which may have resulted from the affection. The true pyriform swelling is best seen in childen, in whom the fluid will be found frequently to pass well up the cord; in adults it is not, however, uncommon.

Statistics of hydrocele.

Hydrocele occurs at all ages, but it is somewhat common at birth and middle age, and in a large proportion of cases appears as a one-sided affection, and seems to affect the right or left testis indiscriminately. Curling informs us that of 115 cases, 65 occurred on the right, 44 on the left side, and 6 were double; while out of 117, my own cases, consecutively observed in which these facts were noted, 41 occurred on the right side, 62 on the left, and 14 were double—results coinciding with the opinions of Velpeau, Gerdy, and others.

General summary.

By way of summary it may be said a chronic vaginal hydrocele appears as a painless enlargement of the testicle, of slow and unequal growth, and of variable size, with a smooth and uniform surface, and more or less tense and fluctuating feel. It is invariably movable within the scrotum, and, as a rule, appears to be distinct from any abdominal connections. The presence of the testis within the swelling can generally be made out by the testicular pain which is produced by pressure at its posterior and upper portion, if the tumour be large, and at its lower if small; or by the absence of translucency at one spot—the tumour, as a rule, transmitting light when its scrotal coverings have been well stretched. It has a tendency to remain tranquil for many years, and by age simply increases in size. It occasionally grows to enormous dimensions, when the penis may become buried within the swelling, but never proves dangerous to life. It causes pain and requires treatment mainly from mechanical causes.

Hydrocele of cord, symptoms and diagnosis.

Congenital.

Diffused.

Encysted.

Hydrocele of the Cord.—It has been already briefly explained how a hydrocele of the cord may be produced, and under what circumstances it may appear as a *diffused* or a so-called *encysted* tumour. It has likewise been shown how these two conditions are but modifications of the same disease, the diffuseness or isolation of the affections being determined by the adhesion, or more or less complete closure of the vaginal process of peritoneum as it passes downwards into the scrotum. Thus, a *congenital hydrocele* of the cord will be present when, from a want of closure at the abdominal orifice of the vaginal peritoneal process, serous fluid can gravitate downwards towards the testis. A *diffused hydrocele* of the cord will be said to exist when, either at an early or late period of life, serous fluid collects in the vaginal peritoneal process, which is closed above at the internal ring, and below at any point above the upper portion of the testis. While in a third class of cases an *encysted hydrocele* of the cord may appear as a small isolated bag of serous fluid movable with the cord and connected with it, situated between any of these points (Fig. 377); its circumscribed nature having been determined by a more complete closure of the vaginal peritoneal process, and the limited space into which the effusion has taken place.

Pathology.
Symptoms.

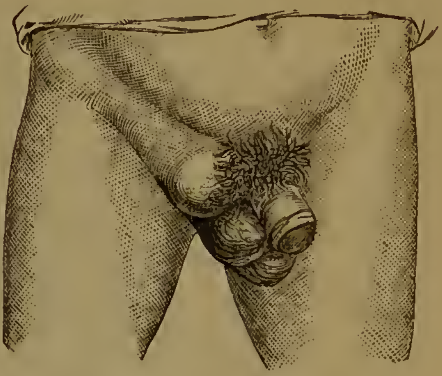
Under all these conditions, however, the pathology of the affection is the same, and the symptoms indicating its presence vary only according to the size and tension of the sac which contains the fluid. In the congenital form, in which a communication exists with the peritoneal cavity, the hydrocele will fluctuate and have a smooth and uniform outline, but it can never be tense. It will also disappear more or less readily by pressure, or by elevating the testicle on the patient assuming the recumbent position, when the fluid will gravitate into the abdominal cavity with a rapidity which varies according to the size of the peritoneal communication.

In the diffused hydrocele of the cord this disappearance of the swelling by rest or pressure will not take place, for in such the opening of the vaginal process will have closed naturally. The tumour will thus appear as a baggy or tense elastic swelling in the inguinal canal, which it will more or less fill. It will give to the hand a sensation of fluctuation, and, in certain instances, may appear translucent. It will, moreover, on any traction of the testicle, be found movable, and painful, in proportion to the amount of tension of the cyst or of the inflammatory action.

In the more localised or apparently cystic hydrocele of the cord, the same symptoms will present themselves. The tumour will be more isolated, probably more movable and more tense, and it will be readily acted on also by any traction on the testis. It may occur as a single cyst or as many cysts, but each will present the same symptoms. When a single, tense, movable cyst exists, it may be mistaken for a distinct morbid growth; but the diagnosis of the case ought not to be difficult when care is observed. Fig. 377 well illustrates the ordinary appearance of the affection.

Single cysts may simulate morbid growth.

Fig. 377.



Encysted hydrocele of the cord.

Treatment of hydrocele.

Of congenital.

Treatment of the Vaginal Hydrocele of the Testis.—In the *congenital hydrocele* of young life surgical treatment should be very simple, for the disease, as a rule, readily disappears with age and increasing strength. A little cold lotion applied to the part, such as a solution of the hydrochlorate of ammonia and tonic medicine, is frequently sufficient to effect a cure; for, as I have already stated, the effusion into the vaginal sac in these instances seems to be often of a passive nature. The hydrocele found in infancy is not, however, always of the congenital form. A hydrocele may exist in an infant in which there is no communication with the peritoneal abdominal cavity through the neck of the vaginal process, and, under these circumstances, a different treatment may be required. Cold lotions and tonics may be of use, and certainly should be primarily employed; yet in many instances the treatment will fail to cure the case. *Acupuncture* may be then employed, and the fluid allowed to escape into the cellular tissue around the sac, when it may be altogether removed by absorption; but this treatment is not, as a rule, satisfactory, it being exceptional for a permanent recovery to be secured by such means, and I am disposed to think it better practice to draw off the fluid by means of a fine trocar and canula, and to excite some fresh action in the membrane lining the

Of infantile.

Acupuncture.

tunica vaginalis by stirring it up with the end of the canula. This practice has been very successful in my experience.

Of adult.

The treatment of vaginal hydrocele in the adult.

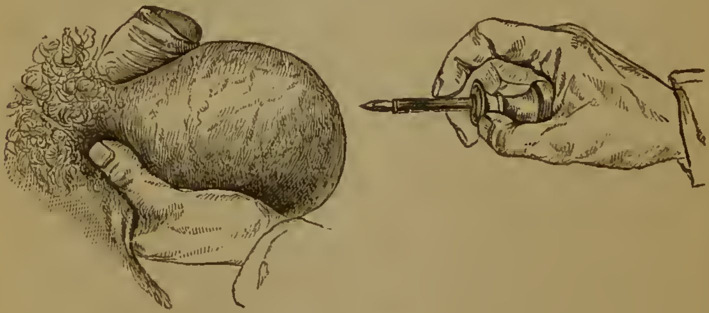
In early examples, when the hydrocele is still small, and consequently of little inconvenience, it is well, perhaps, to leave it alone, for unless it causes anxiety to the patient, or proves troublesome or inconvenient from its size, there is no necessity for interference. *In very old people* it is as well not to interfere, unless a strong necessity exists, as sloughing of the scrotum, suppuration of the sac, and other bad results, occasionally occur in these cases from slight causes. It must be added, that the feelings of the patient as to the amount of pain and inconvenience are the best guide to interference, very slight enlargement causing as much pain in some patients as a greater increase in others. If, then, some treatment be demanded, simple tapping should be performed as a primary measure, the fluid being drawn off by means of a moderate-sized trocar and canula. In doing this, some care is necessary, although the operation is really simple, as difficulties are often made by the operator, while dangers result from want of caution.

On the Tapping of a Hydrocele.

On the operation of tapping a hydrocele.

As a point of primary importance, the true position of the testicle should be defined. In the majority of cases it will be found at the posterior part of the tumour and towards its lower part, unless the hydrocele be very large. At times, however, as has been observed, it will be found in front from a congenital malposition, as well as in certain other cases which are difficult to explain. The true position of the gland can generally be made out by manipulation, and further by the want of translucency in the tumour at the part it occupies. Having made out to a fair certainty the position of the testis, the tumour should be taken in the left hand and grasped firmly at its neck—the Surgeon taking care at the same time to stretch the integument well over the cyst, and to render its wall tense and unyielding (Fig. 378). The trocar with well-fitting canula (having been previously well-oiled) should then be taken in the right hand, with the index-finger placed about three quarters of an inch from the extremity of the canula, while the front of the thumb rests on its flange. The object of this position of the finger is to prevent the instrument going in too far with a rush,

Fig. 378.



Tapping a hydrocele.

and thereby endangering the testicle; and that of the thumb to press home the canula as the trocar is being withdrawn. The tumour should be punctured at its lower part, care being taken to avoid any large vein, and the fluid allowed to run out. Having completely emptied the cyst, the punctured integument should be firmly held and nipped up with the thumb and finger of the left hand, and the canula should be withdrawn. A little cold air or the irritation of the finger generally causes sufficient contraction of the dartos to close the wound and prevent hæmorrhage or any further escape of the remaining fluid. A piece of lint, however, may be applied over the puncture for purposes of cleanliness and to prevent friction.

May excite inflammation in certain cases.

In certain examples of this disease in the adult I have been induced to stir up the cyst as I have described in the hydrocele of the young, and have met with some success. In no instance has any evil consequence resulted from the practice, and in several, a cure has taken place, evidently from inflammation. I would advise this practice to be confined, however, to young adults. As a palliative practice it is scarcely necessary to recommend any other than that described, as it is simple, more efficacious than any other, and not more dangerous. Acupuncture has been advised, but it has no practical advantage over the simple tapping, and it is certainly less successful in its result. In exceptional cases it may be good, particularly in such a case as Mr. Curling has described on the authority of Mr. Luke, of a gentleman who was about to proceed to a part of the world where surgical advice could not be secured, and where the patient could then perform this simple operation on himself. I have more than once known a patient to tap himself.

The operation a most simple one.

The period of relief which a patient experiences from a simple tapping varies exceedingly from a few weeks to many years; and even in the same patient the interval will be found to vary from time to time. In the young and middle-aged adult, when the general health is sound and a return of the effusion has taken place, unless any personal objection should be made, it is generally advisable to adopt some plan for a more permanent cure. In old men it is the soundest practice to rest satisfied with the palliative treatment; and in such the radical cure should be proposed only in exceptional cases.

Treatment of hydrocele of cord.

Treatment of hydrocele of the cord.—The principles of treatment which have been laid down in cases of hydrocele of the testis are likewise applicable to those of hydrocele of the cord, their application requiring only such modifications as may be demanded by the altered position of the affection. In the *congenital* hydrocele, no special treatment is required, because as strength comes to the child, the fluid probably will be re-absorbed; failing this result, tonics should be given to expedite the cure, and some cold lotion, such as the chloride of ammonium with vinegar, ʒj to Oj, should be applied.

Treatment of diffused form.

In the *diffused or encysted* hydrocele of the child or adult, more active treatment is frequently though not in all cases demanded; the fluid will at times disappear without treatment, though it may recur at a later date; still the affection ceases to trouble, and, unless some real inconvenience is produced by its presence, it is as well to leave things alone. When, however, pain or inconvenience is experienced, something must be done, and no doubt the best practice is to evacuate the fluid. In small, tense, encysted hydroceles, the practice of evacuating the fluid by acupuncture is certainly sound, since tapping by the trocar and canula is an operation of some difficulty where the cyst is small. It may be done with any needle, but those employed for cataract are probably the best, and several openings should be made. Tapping may be employed as in any other case of ordinary hydrocele. I have effected on several occasions the radical cure by injection, and have not met with any bad results. When this treatment fails, and further measures are demanded, as a last resource, an incision into the cyst may be made.

On the Radical Cure of Hydrocele.

On radical cure of hydrocele.

It is not necessary to review all the various plans which have been and are now employed for the permanent cure of a hydrocele of the tunica vaginalis. It will be more to the purpose to give the line of practice which is most successful, and which at the same time is very simple, viz. the injection of the cyst with a solution of iodine. It is perhaps not a question of much importance whether the fluid should be concentrated or diluted, or whether it should be permanently left in the cyst, or withdrawn after a few minutes have been allowed for it to act upon the secreting surface, such minor differences may be left to the fancy of the operator. My own judgment leans towards the practice of injecting from two to four drachms of a mixture of equal parts of the tincture of iodine and water, and allowing it to remain, care being taken that the canula is previously well pushed home into the cyst, and that no iodine solution is allowed to escape into the cellular tissue outside the sac. By this practice a radical cure is almost certain to be secured, and only exceptionally does any failure or evil result follow. The American Surgeons are fond of injecting from half a drachm to a drachm of pure carbolic acid liquefied with water or glycerine, into the sac, and, Dr. Levis reports, with success. In obstinate cases a free incision into the tunica vaginalis, and filling the cavity with carbolic or iodoform gauze, to make it fill up by granulation, is also to be recommended. When a cure does not occur, it is generally due to the fact that a hydrocele has been injected when some inflammation of the testicle co-exists, and from which it has been produced. In all examples of hydro-testitis the practice of injection must be looked upon as injurious, and is treating the result of a disease, and not the disease itself, the effect, and not the cause. Within the last few years, where the iodine has failed, I have often used warm water as an injection. It answered well, but set up more inflammatory action than the iodine; indeed, in several cases, it excited suppuration. Some of the Dublin Surgeons speak highly of the practice of introducing into the sac of the tunica vaginalis a grain or more of the biniodide of mercury made into a paste with some grease, and I have followed this practice in some cases with advantage. I prefer, however, the iodine treatment.

Selection of injection and its strength.

Incision.

On Encysted Hydrocele of the Testis.

On encysted hydrocele of testis.

On examining the testis of the adult after death it is by no means an uncommon occurrence to meet with small cysts connected with the epididymis. These may be single or multiple, and, in many instances, are very numerous. These cysts are generally more or less pedunculated, and, as a rule, are connected with the upper portion of the epididymis.

They are filled with a clear, watery fluid, which contains, in certain cases, some granules.

Pathology.

The pathology of the formation of these cysts is somewhat difficult to understand, and, surgically, is of small importance, since they seldom, if ever, become of sufficient size to cause inconvenience, or to require any operative interference; indeed, they are rarely diagnosed during life, and are only discovered on post-mortem dissection.

Variety.

Another kind of cyst is occasionally met with connected with the testis, and in close contact, if not associated, with the epididymis. It has been described as the encysted hydrocele. It springs from the same part as the smaller cyst, but grows to much larger dimensions, and generally contains a very different kind of fluid. Its origin is as obscure as the former kind of cyst. It enlarges very slowly, does not give rise to any pain, nor does it produce any inconvenience other than that caused by its size. It seldom requires treatment in its early stage, and, as a rule, many years are allowed to pass before interference is demanded, the tumours frequently developing for twenty years or more before advice is sought. These cases are by no means so common as the ordinary vaginal hydrocele—not more than 5 per cent. of the cases of hydrocele being of this kind.

Frequency.

Another variety.

A cyst is occasionally developed between the tunica albuginea of the testis and the tunica vaginalis testis, the pathology of which is very obscure. Mr. S. Osborne suggests, and I think with good reason, that this is merely an enlargement of the corpus or hydatid of Morgagni—a constant structure, existing as a pedunculated vesicle situated between the summit of the globus major and the body of the testicle, between the visceral layer of the tunica vaginalis and the tunica albuginea ('St. Thomas's Hospital Report,' 1874). Cases of this kind are described by Curling and Hutchinson. Guy's Museum contains a specimen. I know of no means of diagnosing their existence. Their treatment would be similar to that of other cysts.

Symptoms.

Symptoms and diagnosis.—In an early stage of encysted hydrocele the diagnosis is not difficult, as the cyst usually appears as a kind of budding of the testis or rather of the upper portion of the epididymis; as a tense, hard, globular, and, in some cases, pendant tumour, more or less intimately connected with some portion of the spermatic duct. It is generally discovered on the part of the patient by accident, and, when as large as the natural testicle, has been set down occasionally as an extra organ.

The Surgeon is not often consulted in such a case in its early stage; the tumour usually having been allowed to grow to an inconvenient size before advice is sought. In forming a diagnosis, the history of the case will often at once throw some light upon its nature; and, in all probability, it will be found that the increase has been extremely slow, twenty years or more often intervening before the cyst attains anything like a large size. These encysted hydroceles probably never grow so fast nor acquire such dimensions as the more common vaginal species.

Peculiarity in shape.

The next feature demanding attention in the development of these cysts is their shape and outline, which are often rather striking. They never in their early stage, and rarely at any time, assume the appearance of ordinary vaginal hydrocele, and almost always maintain a globular outline.

Position of testis.

The position of the testis in its relation to the cyst next claims attention, and a marked difference exists between the encysted and the vaginal hydrocele. In the vaginal, as a rule, it is to be found at the posterior part of the sac—when the tumour is small towards its lower, when large towards its upper part. In the encysted, it is to be found in front, to one side, or below, and rarely at the posterior part. The reason for this is easily explained. The cyst is usually connected with the epididymis which normally lies at the posterior part of the gland.

Nature of cystic contents.

Vaginal hydrocele.

Encysted hydrocele.

The nature of the cystic contents differs also in many points from the fluid of a vaginal hydrocele, and is very characteristic. In the *vaginal* hydrocele the fluid has been described as being generally clear, like the serum of the blood, more or less albuminous, of a straw colour, and, at times, spontaneously coagulable, blood and cholesterin being also occasional elements. In the fluid of an *encysted* hydrocele none of these elements are generally present; but, as a rule, it is a limpid, feebly saline, watery liquid; at times it is slightly opalescent, as if mixed with milk, and then it will be found to contain some granules in suspension, and frequently spermatozoa. Cystic hydrocele differs from the vaginal in the slowness of its growth, its globular outline, the anterior position of the testicle, and the nature of its cystic contents.

Origin of spermatozoa.

Illustrative case.

The origin of the spermatozoa in these cysts is a point of peculiar interest, and has been a disputed point with pathologists for many years. Mr. Curling's investigations on this subject have proved that, in some instances, their presence is certainly due to the rupture of one of the spermatic tubes which pass over and are in close connection with the walls of the cyst—this rupture taking place generally from an injury, and being indicated by some rapid increase in the size of the cyst. Mr. Curling has shown that this history was given in several of the cases in which spermatozoa were found, and in some he was even able to demonstrate a distinct communication between the cyst and the spermatic tube. The following case tends to support his views. Robert P—, æt. 60, came under my care, at Guy's Hospital, on December 28th, 1863, with an encysted hydrocele of the left testicle of twenty years' growth. The increase had been very slow until the last month, when the tumour had doubled its normal size, this rapid growth having followed an injury produced by a fall. When first under my observation the scrotum contained an irregular cystic tumour on its left side, evidently made up of several cysts, of which three of large size could readily be distinguished, two being very tense, while the third was baggy. The testis was found on the inner side of the tumour. Tapping was at once resorted to, and the largest cyst emptied, many ounces of a milky fluid being drawn off. The second tense cyst was then tapped through the same opening, with a similar result, and the fluid collected in a distinct glass. The third cyst was also tapped, but in this the fluid was quite watery. The first two contained abundance of spermatozoa, while the third did not contain any. A good recovery took place.

Treatment of encysted hydrocele.

The treatment of encysted hydrocele.—However interesting the two forms of hydrocele which we have just been considering may be, both in their pathology and in their points of difference, the treatment in the two cases is practically alike. When anything is required to be done, simple tapping may suffice, and, as a primary measure, it should always be preferred; but, should the radical cure be required, the injection of iodine may be carried out. The slow growth of these cysts, however, and the equally slow re-accumulation of their contents, after tapping, are points which indicate the propriety of adopting the palliative treatment in the majority of cases.

On Ruptured Hydroceles.

Rupture of. It is well known that in children hydroceles, as a rule, disappear spontaneously with little or no treatment, but in adults such a result is most uncommon. Messrs. Pott, Curling, and Sir B. Brodie relate cases of this kind, and attempt to explain the process by which such a recovery takes place with more or less success. A single instance of the kind has passed under my hands for treatment.

Case. Charles C—, æt. 64, came to Guy's Hospital on Jan. 29th, 1863, with a hydrocele of the left testis, the size of a cocoa-nut. It was of two years' standing, and had been tapped six times, under my care each time. He came under my notice at length when I was about to leave the hospital, and I did no more than examine the parts, which were tense and painful, telling the patient to return to me in the course of a few days to be relieved. When he came the following week all indication of swelling had completely disappeared, the man assuring me that he had gone to bed the night of the second day before his visit with a large tumour, and that when he awoke it had disappeared. He added also that on the following morning he had passed a large quantity of thin urine. The patient was a steady man and a widower, and told his tale with all the appearance of truth and with some astonishment. In three months the fluid had again collected, and he was tapped. This case was doubtless an example of subcutaneous rupture of the tunica vaginalis.

In the following cases the rupture took place without hæmorrhage. Rob. M—, æt. 66, came under my care in 1879, for a hydrocele of the right testis. It commenced six years before, and steadily increased up to one year and a half ago, when he accidentally struck it, and in four or five hours the whole swelling had disappeared. He remained well for three months, when it began to increase, and on admission the tumour was the size of a fist. It was tapped and injected with iodine with success.

At times rupture of the tunica vaginalis is followed by a blood tumour, and this occurs when any large vessel is ruptured. It took place in the following case.

R. B—, æt. 50, came under my care in July, 1879, with a large scrotal tumour. He said that his right testicle had been large for years, but that he had never been tapped. Four days before his admission, when sitting at his desk, he felt a pain in his scrotum, and on putting his hand to it he found it enlarging, whilst the swelling of the testicle was rapidly diminishing. The scrotum continued to increase for three days, when it ceased to do so, and he came to Guy's. When admitted the scrotum was very large, and measured in circumference 23 by 16 inches. It was uniformly smooth and but slightly painful. The groin had an ecchymosed appearance, and was brawny. Ice was applied. On the fifth day I cut into the tumour and evacuated from the scrotal integuments a mass of blood. Having done this, a rent about two inches long was clearly visible in the tunica vaginalis, and within this cavity was blood-stained serum and clot. On turning this out the testicle was visible. The cavity was cleared out, washed with iodine water, and drained; and in the course of two weeks the patient was well, the cavity having granulated.

The nature of these cases is not generally recognised.

HÆMATOCELE.

On hæmatocele.

As the term "hydrocele" is applied to the effusion of serous fluid into the sac of the tunica vaginalis and of its tubular prolongation upwards to the internal ring, as well as into the cysts which have been already described as being connected with the testis, so the term "hæmatocele" is employed to designate an effusion of blood into the same parts. We thus have—

A "*vaginal*" and an "*encysted*" hæmatocele of the *testis.*

A "*diffused*" and an "*encysted*" hæmatocele of the *cord.*

Diffused or encysted.

Hæmatocele may occur in an organ which had not previously shown any symptom of disease, or, it may be, associated with a hydrocele. It may appear spontaneously without an injury, or as the result of a blow, strain, or the tapping of a hydrocele. It may attack patients at any period of life, and in certain rare cases at a very early age, even in infancy. I have the records of a case in which it was said to have made its appearance at two years of age.

Causes.

In the notes of my cases various causes have been assigned for its production. In more than one instance "it appeared gradually without any known cause." In another "it occurred when hard at work pushing a wheelbarrow, something giving way with a snap." In the majority it came on as an immediate consequence of a blow, and in several as the result of the tapping of a hydrocele. In all, however, the result was the same—a more or less rapid formation of a tumour in the position or neighbourhood of the testicle.

Symptoms.

Symptoms and diagnosis.—The symptoms of a hæmatocele which has made its appearance without any injury or assigned cause are very obscure, and are pretty well summed up in the prominent one of a gradual and uniform enlargement of the organ. The swelling will vary in shape, as in a hydrocele, but, like it also, may present a more or less pyriform outline. The testicle will always, in the vaginal hæmatocele (on careful manipulation being made), be detected somewhere in the sac, and usually at its posterior and lower part, the peculiar testicular sensation being produced by slight pressure.

When caused by injury.

When caused by a sudden strain or injury, the enlargement will be more sudden as well as rapid, and be found to follow close upon the receipt of the accident, while the rupture of the blood-vessel may be announced by the sensation of a sudden snap or giving way.

The local symptoms are similar to those already described.

The tumour, on its first appearance, may be somewhat soft and obscure, or clear fluctuation may be detected in it; but if much time be allowed to pass before coming under observation, this fluctuation will not, in all probability, be made out, for the effused blood rapidly coagulates, and gives rise to the sensation of a solid growth. The sac of the hæmatocele, whether tunica vaginalis or cyst, rapidly alters in character, and becomes thick, and in certain cases fibrinous, or even cartilaginous; at first from the coagulation of the fibrine of the blood upon its inner surface, and, in cases of longer standing, from distinct inflammatory changes, brought about by the presence of the blood acting as foreign matter. In some instances this thickening of the cyst is very great, even to the extent of half an inch.

When following hydrocele.

When a hæmatocele has followed upon a hydrocele, there will usually be a sudden enlargement of the part after the strain or injury, accompanied with more or less pain, this pain apparently depending upon the amount of distension to which the cyst has been subjected. If it follows the operation of tapping it will, as a rule, be recognised by the escape of more or less blood or bloody fluid at the time of operation, and the rapid re-filling of the hydrocele sac or cyst with a more solid and opaque material.

To form a correct diagnosis of hæmatocele the history of the case is most important; indeed, more so than the local symptoms, for it is certainly true, that by the latter alone, in some instances, it is almost impossible to make out the true nature of the affection.

Summary.

By way of summary it may be stated that a hæmatocele is usually a uniformly smooth, tense, and *non*-transparent tumour, with an *indistinct* sensation of fluctuation, but with *distinct* evidence of testicular pain on pressure. It may be accompanied with pain during the early period of the affection from the distension of the cyst, but not at a later date, or during its chronic stage, unless softening down. As time passes, it will become harder if no symptoms of inflammation show themselves; but on their manifestation, evidence of suppuration will soon appear, for hæmatoceles have not, as a rule, a disposition to remain quiet like hydroceles, but tend to open outwards by the breaking up of the coagulated blood which has been effused, and the inflammatory process.

Symptoms of hæmatocele of spermatic cord.

The symptoms which indicate the presence of a *hæmotocele of the spermatic cord* are somewhat similar to those already described for vaginal hæmatocele, the difference in locality being remembered. It is generally produced by a blow or strain, as in the ordinary vaginal hæmatocele. It can be diagnosed by the suddenness of its appearance, or the suddenness of the enlarged hydrocele sac, by the opacity of the swelling and tendency to consolidation which it possesses, also by the accompanying ecchymosis of the parts. Cases are recorded by Bowman, Curling, and others, in which this disease obtained enormous dimensions, but such examples are very rare; the affection being very uncommon.

On the source of the blood in hæmatocele.

On the Source of the Blood.—A very common question with students is, as to the origin of the blood in these cases of hæmatocele, and in the spontaneous cases, and those following a strain or injury with an apparently sound testis, this question is difficult to answer with certainty of accuracy. There can be little doubt, however, that a distinct rupture of some of the vessels, probably veins, which ramify upon the body of the testis, or on the tunica vaginalis, must have taken place.

When occurring upon a hydrocele or after the operation of tapping, it is probably due to the distinct rupture or perforation of one of the large veins which ramify outside the tunica vaginalis, into its interior, or of one belonging to the body of the testis.

Scarpa relates a case of hæmatocele in which the spermatic artery was wounded, and Sir A. Cooper another, in which a distinct rent in the tunica vaginalis was found on dissection. This latter condition is probably the most common.

Treatment of hæmatocele.

Treatment.—The treatment of hæmorrhage into the tunica vaginalis testis, or cord, differs in no respect from the treatment of hæmorrhage into any other part of the body. In the very earliest period of its occurrence, rest in the horizontal posture, with the testicles well raised and the application of cold, either as ice in a bag, or by means of the metallic tube, are the most efficient means to arrest the flow of blood and relieve pain. By such means the blood may also be reabsorbed, and all future mischief prevented. Should the blood, however, remain fluid for a long time, and no symptoms of reabsorption or of inflammatory action manifest themselves, it is a sound practice to draw off the fluid contents with a trocar and canula. I have had a case in which this course was adopted with good effect.

Free incision.

If signs of inflammation appear soon after its occurrence, cold lotions and leeches, with the aid of saline purgatives, may occasionally be found efficient in arresting its progress, and to allow of the subsequent reabsorption of the effused blood. But should symptoms of suppuration show themselves, or of the softening down of the coagula, a free incision into the cyst or tunica vaginalis is the only sound practice, the whole semi-solid contents being thoroughly turned out, and the interior of the sac allowed to granulate. In old and chronic cases, with thickened sac walls, the same treatment is also effectual. I possess the records of many cases in which this plan was carried out with marked benefit. In one case of only four months' duration, and in another of twenty-nine years, in which the tunica vaginalis was at least half an inch thick, and in both, a good recovery followed. I need hardly add that excision is rarely called for in the treatment of these cases, although, owing to difficulties in the diagnosis, it may occasionally have been had recourse to. I have seen several such instances, but beyond the loss of the organ no evil resulted. In old cases of hæmatocele in aged subjects, the practice of excision is probably the best; but in the young and middle-aged it cannot be advised. The treatment of hæmatocele of the cord is to be conducted on similar principles.

Excision.

ON DISEASES OF THE TESTICLE.

On Inflammation of the Testicle.

On inflammation of testicle.

Division of subject.

Under the term *Orchitis,* most authors have been in the habit of including the inflammation of two distinct portions of the testicle, and of mixing up the symptoms of two affections to the prevention of a sound and clear understanding of the subject. In this chapter I shall separate the two, and describe inflammation of the epididymis as one affection, and inflammation of the true secreting gland as another, calling the former "*epididymitis,*" and the latter "*orchitis.*" In certain cases, it is true, both structures are involved in the inflammatory action, and to this state I shall apply the term "*testitis;*" the three words accurately indicating the true seat of the malady, and their use, consequently, tending to facilitate its better study.

All Surgeons will be ready to admit the distinctness of these two parts, anatomically and physiologically, viz. the epididymis and the gland. It is as well also to acknowledge that pathologically they are constantly divided, and I am certain that, to the student of the affections of this organ, such a division tends to a more ready discrimination and appreciation of the several diseases of the testicle.

As a preliminary to the more special clinical and pathological consideration of these diseases, the following observations of Sir J. Paget, as given by Curling, upon the development of the epididymis and testis may be read with interest and advantage.

Development of genital organs.

Sir J. Paget observes "that, in the normal course of human development, the proper genital organs are in either sex developed in two distinct pieces, namely, the part for the formation of the generative substance, the testicle or ovary, and the part for the conveyance of that substance out of the body, the seminal duct or ovi-duct. The testicle or ovary, as the case may be (and in their earliest periods they cannot be distinguished) is formed on the inner concave side of the corpus Wolffianum, and the seminal or ovi-duct, which is originally an isolated tube close at both extremities, passes along the outer border of that body from the level of the formative organ above, to the cloaca or common sinus of the urinary, genital, and digestive systems below. The perfection of development is attained only by the conducting tube acquiring its just connections at once with the formative organ and through the medium of the cloaca with the exterior of the body. The sexual character is first established when, in the male, the formative and conducting organs become connected by the development of intermediate tubes which constitute the epididymis; or when, in the female, a simple aperture is formed at the upper extremities of the conducting tube, and is placed closely adjacent to the formative organ. In both sexes alike the lower extremities of the conducting tubes first open into the common cloaca, and subsequently, when that cavity is partitioned into bladder and rectum, or bladder, vagina, and rectum, they acquire in each their just connections, and become, in the male, the perfect vasa deferentia, and, in the female, Fallopian tubes and uterus."

I will remind the student that the epididymis naturally forms the posterior and outer part of the testicle, and the secreting portion or true gland, the anterior; that the former in a perfectly healthy state is only indistinctly felt, the vas deferens on being traced downwards from the cord losing itself as it were in this part. The body of the gland can always be made out by its smooth and elastic globular form.

On Epididymitis, or Inflammation of the Seminal Duct.

Epididymitis.

Inflammation of the epididymis may be caused by some local inguinal injury, or the pressure of a truss, but as a rule it is a consecutive affection, and occurs in association with a urethritis, gonorrhœal or otherwise, or as the result of some irritation of the prostatic urethra, such as the presence of a calculus, or the passage of a sound or lithotrite. It is caused by an extension of inflammation from the urethra down the vas deferens to the epididymis, and is an inflammation of the seminal *duct* and not of the seminal gland. It generally comes on suddenly, and is attended with considerable pain; a marked enlargement of the epididymis or posterior part of the testicle forming its chief local symptom. It is constantly preceded by severe pain in the anal and iliac fossæ, and accompanied by special tenderness of the part, this tenderness being readily traceable up the cord, which is occasionally swollen and œdematous. It is usually attended with œdema and redness of the scrotum over the inflamed tube.

The enlargement of the epididymis is very rapid, and in some instances very great. It invariably assumes a special outline when uncomplicated, that is, when confined to this special part, the epididymis appearing of a boat or truncated half-moon shape, holding the body of the testicle in its concavity. The lower portion of this body is usually the most enlarged, being composed of the greater number of the convolutions of the tubes, and consequently containing more connective tissue, since it is from the infiltration with inflammatory effusion of this connective tissue around the inflamed seminal duct that this enlargement is produced.

Generally acute.

The affection generally is acute, comes on suddenly, runs a rapid course, and is accompanied in most patients by some constitutional disturbance. In some subjects this is very severe, while in others it is of a milder description, the sharpness of the inflammation and the peculiarity of the patients influencing the severity

Complications.

It is at times, however, complicated with other conditions, such as an inflammation of the true secreting portion of the testicle, but this complication invariably occurs as a secondary symptom, and is produced by the direct extension of the disease from the seminal duct to the gland. I have never seen a genuine orchitis, or inflammation of the seminal gland as a result of gonorrhœa, except as an extension of the inflammation from the epididymis, and it is in quite exceptional examples of this affection that the body of the testicle is ever involved.

Orchitis.

When the inflammation has extended to the gland itself, the diagnosis is readily made, the enlargement and great tenderness of the part clearly indicating what is the matter. The whole organ presents an expanded but flattened aspect, the swelling of the epididymis posteriorly, and of the body of the testis anteriorly producing this peculiar laterally flattened outline. The two inflamed parts will, however, be always felt distinct from each other, and can be readily distinguished. There is, however, a second complication of epididymitis, more common than that just described, which is, the effusion of fluid into the tunica vaginalis, or the production of an acute hydrocele, and I am disposed to think that it is this apparent swelling of the organ which has given rise to the mistaken idea that orchitis is a common affection after gonorrhœa. The enlargement of the organ from such a condition is, however, very different from that already described as due to an inflamed gland. It is more globular, tense, and elastic; it is certainly equally painful with that affection, but its true nature can be readily made out by its translucency, and the presence of fluctuation on palpation. It is the result of a direct extension of the inflammation from the epididymis to the tunica vaginalis, and the following explanation of its occurrence by Gendrin, as given by Curling, who assents to its soundness, seems most satisfactory, since it is certainly borne out by clinical observation. He says, "when the subserous cellular tissue, which always participates in the inflammation of a serous membrane, penetrates into the interior of an organ, it becomes a ready means of communicating the inflammatory action, but when the contiguous organ in subjacent parts is of a different structure from that of the cellular tissue, the extension of inflammation inwards is checked. Thus, in the case of the inflamed tunica vaginalis, the cellular tissue

Hydrocele.

readily transmitted the morbid action to the epididymis, but the tunica albuginea arrested its progress to the body of the testicle, and this explains the fact that, after inflammation of the tunica vaginalis excited by injection, the body of the gland is rarely found to suffer. On the other hand, the epididymis is seldom attacked with inflammation without the disease being quickly propagated to the tunica vaginalis. The hydrocele, as a rule, however, disappears as the disease subsides in the epididymis, it being exceptional for the former condition to remain when its cause has been removed.

Thickening of seminal duct.

As a consequence of this epididymitis, it is by no means uncommon for a considerable thickening of the seminal ducts and of their surrounding cellular tissue to remain for many weeks or even months. In the majority of cases, however, this result does not take place, for in the healthy subject there is every reason to believe, that with the inflammation all effusion disappears, and the organ is left as sound as it was before. In the cachectic patient this happy event does not, however, always take place, and more or less thickening of the inflamed part will generally be observed, the epididymis feeling indurated and enlarged, and in parts nodulated and cordy. It has been a disputed point by pathologists whether this condition ever leads to an atrophy or destruction of the testicles, or whether it has any influence upon the true function of the organ in causing sterility, and upon this point I have no positive facts to adduce, though I have certainly seen a wasting of the glandular structure of the testicles after inflammation, the result of an epididymitis. In one instance I witnessed inflammation of the body of the testis in a young man who married at a time when he had a marked induration of the epididymis, the result of an attack of inflammation some months previously. I entirely attributed the inflammation in his case to the retention of seminal secretion from the obstruction to the seminal duct, the result of the old epididymitis, since we know that all ducts or canals, when surrounded by organised inflammatory products, are liable to obstruction or stricture, and it is only right to believe that the spermatic ducts are obedient to the same law, although this result may not be very common.

Obstruction of seminal duct.

On the dictum of Sir A. Cooper it has generally been asserted that the left testis is more often attacked in cases of epididymitis than the right, but Curling's figures and my own disprove the truth of this assertion, and show that in 202 cases of this affection the right testis was the seat of the disease in 113 examples, the left in 74, and both glands in 15. *The right organ is, therefore, more often affected than the left*, while in hydrocele the *left* side is the most frequent seat of disease.

Right testicle most frequently attacked.

With respect to the cause of the disease, I took some pains during the eight years I was registrar at Guy's to find out if the general opinion was correct, that the epididymitis usually supervened on the disappearance of the urethral discharge, and was relieved on its reappearance; or if it could be traced to any peculiarity in the treatment of the gonorrhœa, to any neglect, or other cause. I have to confess that I was not able to connect these phenomena in any way, as the epididymitis made its appearance during all stages of the complaint, and under every kind of condition; when injections were employed, and when they were not; when copaiba and cubebs had been taken, and when they had not; although in some cases the diminution of the discharge and appearance of the epididymitis were coincident; but

As to the cause of epididymitis.

such a result is only consistent with the general rule, that an inflammation set up in one part tends to relieve an inflammation existing in another, and more particularly in a neighbouring tissue. The disease, however, appeared in the majority of cases of neglected gonorrhœa, and in others, in which strong injections had been recklessly employed; but more particularly in the cachectic and irregularly living patients, who had been utterly regardless of their affection, and taken no means to keep the testes well suspended.

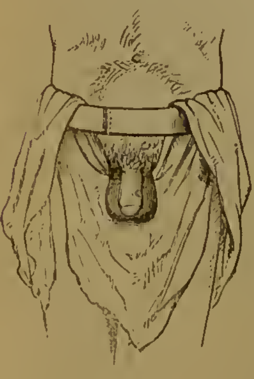
Treatment.

Treatment of Epididymitis.—The treatment of this affection must depend upon the intensity of the inflammation and the severity of the local and constitutional symptoms which it produces. Rest in the horizontal posture, with elevation of the testes, or even of the pelvis, active purgatives, with saline medicines, combined in acute cases with tartar emetic or colchicum wine are advantageous; the local application of ice, hot poppy fomentations, or swathing the parts in cotton wool, are often sufficient to check the disease at its onset, and prevent its passing into a chronic stage. It is also a wise measure to administer an opiate at night. When the local symptoms and pain are very severe, leeches may be applied to the neck of the tumour, or one of the turgid veins in the scrotum opened. The use of mercury does not appear to be of much value, except as a purge.

Suspension.

If the patient, however, from social reasons, objects, or is unable to keep at rest, the parts must be well supported by a suspensory bandage, and a very efficient suspensor is formed by a handkerchief folded crossways in a triangle, the apex of which is well braced up posteriorly by a piece of tape or bandage, and the base attached firmly to a band brought round the waist. The same treatment must then be pursued as we have already indicated (Fig. 379). A better mode of supporting the testicles is by attaching two loops of tape three or four inches apart to the central portion of the posterior flap of the shirt, and two long tapes to the bottom of the shirt front. On drawing the posterior flap between the legs, and looping the front tapes through the posterior loops, a most comfortable and efficient support is obtained.

Fig. 379.



Pressure.

In the chronic form.

The treatment by compression, by means of strapping or an india-rubber bag has also been strongly advocated. I have used it but little in the acute affection, although in the more chronic or subacute, when the disease has passed into an inactive stage and little remains behind but the *product* of the inflammatory process, the treatment by pressure appears very valuable, indeed, more so than any with which I am acquainted; nothing tending more to hasten the absorption of the inflammatory product. (Fig. 383.)

Puncture.

Vidal's plan of puncturing the tunica vaginalis or even the testis itself, has been freely practised by some English Surgeons, and Mr. H. Smith speaks highly of its value. I have, however, never seen a case calling for so severe a measure. When tension exists an incision into the tunica vaginalis may be made with impunity, but I should hesitate to puncture the testicle unless suppuration were present.

Pressure with or without mercury.

If mercury is ever needed in this affection, it is at the chronic stage; as its power, doubtless, lies in its tendency to produce disintegration of inflammatory products, so it prevents the organisation and subsequent contraction of such in and around the spermatic ducts, and thus guards against the special evil effects of epididymitis. When I have had occasion to use it, I have done so as an ointment applied with pressure to the part, but how far the good results which I have had from the practice has been due to the pressure alone I am unable to say. Of late I have been accustomed to employ simple pressure in these cases, and have no reason to believe my success has been less favourable than previously.

If suppuration takes place as a consequence of epididymitis—a result which occasionally happens—it is well to open the abscess early, and freely; by such a practice the discharge finds easy vent, and the formation of sinuses is prevented. Simple dressing to the part, and the use of the suspensory bandage are the best subsequent local means, while tonics and good living are generally required.

On Acute Orchitis or Inflammation of the Seminal Gland.

On inflammation of body of the testicle.

Orchitis or inflammation of the seminal gland as an *acute* affection, for the most part, occurs as the result of an injury, but it appears at times spontaneously without any such cause, and more particularly in connection with parotiditis or mumps. It may, too, be due to an extension of inflammation from the epididymis or spermatic duct, but it rarely, if ever, takes place as a primary affection in connection with urethritis or gonorrhœa.

Orchitis of malplaced testicle.

Acute orchitis may also attack the gland in its descent into the scrotum; the following case illustrates this fact:—Robert H—, æt. 12, was brought to me at Guy's Hospital on June 20, 1859; and as he walked into the room it was at once observed, that his body was bent unusually forward, and his movement much restrained. The *right* testicle not having descended from the abdomen could not be felt, and the *left* had first shown itself at the external ring three days before the boy's application. Pain in the groin, extended upwards towards the loin, had been experienced for two weeks previously. The testicle, which had passed down the canal and partially through the external ring was about as big as an egg, and remarkably tender. The horizontal posture was ordered to be maintained with the thigh flexed, and cold lotion or ice applied. In three days, the symptoms had somewhat abated, and at the end of the week the swelling was much less. On July 11th, or the 21st day after coming under observation, the testicle had passed the external ring, although resting close to it in the scrotum. In another week all pain had subsided; the testis was free, and the patient disappeared from observation, being quite well.

Acute inflammation of undescended testis, simulating hernia.

On August 16th, 1871, I saw with Mr. Forman, of Stoke Newington, a boy, æt. 14, with acute inflammation of the left testis, which was at the internal ring. It was accompanied with such severe local and abdominal pain, constipation, and vomiting, as to lead Mr. Forman to suspect the presence of a hernia. I saw the patient with these symptoms, and finding an inflamed painful inguinal swelling the size of an egg, I explored it with a scalpel, and discovered the tunica vaginalis filled with pus and a small undeveloped testis. All the symptoms speedily subsided after the operation, and a good recovery ensued.

Symptoms.

The *symptoms* of acute orchitis are very marked and its diagnosis easy, for the rapid enlargement of the body of the gland, its flattened oval form, and extreme tenderness, are very characteristic. The patient will complain of its weight, and, if standing, will probably assume a bent posture. The disease will be accompanied by extreme local tenderness, and pain of a dull aching character which passes up the loins, round the hips, and often down the thighs. The scrotum will probably manifest some symptoms of inflammation, such as swelling, redness, heat, and increased vascularity. In exceptional examples there will be effusion of fluid into the tunica vaginalis, but this complication is not so common after acute orchitis as after epididymitis, for reasons which have been already given.

The constitutional symptoms will be those of general irritative fever, and vary according to the susceptibility of the subject of the disease; in some cases they will be very severe, and in others less so.

As a rule, it may also be asserted, that acute orchitis tends towards recovery and seldom terminates in suppuration, unless it be of the tubercular form, or affecting very cachectic patients. In one known example, it ended in gangrene of the part. This case was recorded by the late Mr. Harvey Ludlow in his unpublished Jacksonian prize essay. It was under the care of Mr. Stanley, who was induced to cut into the gland from the severity and obstinate character of the pain, and a black gangrenous cavity was exposed, which was seen after death to have occupied half the organ. I have the records of a case in which the patient stated that one testicle sloughed out after inflammation six months previously; the man came under treatment for inflammation of the other. The termination by suppuration, however, occasionally takes place, and numerous are the examples of this condition which I possess. These cases may also at times end favourably, the abscess healing without any evil result, but too frequently the discharge of the abscess ends in what has been variously described as benign fungus of the testis, granular swelling or hernia testis. The latter is the most correct and intelligible name, the affection being the result of rupture or ulceration of the tunica albuginea, and the gradual extrusion or hernia of the tubuli of the gland, the extruded gland being covered with granulations. The true nature of this affection was first described by Sir W. Lawrence in 1808 ('Edinburgh Med. and Surg. Journal,' vol. iv, p. 257).

Gland occasionally suppurates.

Association of orchitis with parotiditis.

Acute orchitis as a consequence of parotiditis or mumps is a well-recognised affection, although it may be difficult to explain the connection between the two. It is described by some as a kind of metastasis, but there are no published facts tending to support this view; no one, however, is disposed to deny that the one affection occurs in connection with the other. The disease is not usually very severe; it commonly passes away with little treatment, and leaves the testicle sound, few cases being on record of atrophy of the glands attributable to this disease. The symptoms are precisely similar to those already described, and need no further illustration.

Treatment.

Treatment of Acute Orchitis.—The ordinary principles of treatment applicable to local inflammation in general are to be acted on in the treatment of this affection. Rest in the horizontal posture with elevation of the parts and cold or warm fomentations, according to the relief they afford, are points to be attended to; leeching the groin or local venesection, and saline purgatives with sedatives are the chief remedies. The disease has a tendency to get well by itself, and, unless badly treated or neglected, or attacking very cachectic subjects, this will generally be attained. In extremely severe examples, when the inflammation runs high, tartar emetic in full doses is a most valuable drug; while colchicum in half-drachm doses of the wine, with saline purgatives, often acts like a charm. Opium in full doses may also be given where pain is severe, and constitutional disturbance great. An acute attack, however, generally runs its course in about ten days, and seldom ends otherwise than well.

On Chronic Orchitis.

On chronic orchitis.

Chronic inflammation is the most common of the true diseases of the seminal gland, and may follow the acute affection or an injury, but most frequently it is induced by some special constitutional condition, such as gout, tuberculosis, and more particularly syphilis.

The general symptoms of chronic orchitis, from whatever cause, are much alike, although they differ in some minor but important points. In the syphilitic affection the symptoms are somewhat peculiar, and, as its diagnosis is important, it will receive special consideration. The subject will consequently be divided for consideration into the ordinary forms of chronic orchitis and syphilitic orchitis.

Symptoms.

Chronic inflammation of the testicle comes on most insidiously, and unless it follows an acute attack, is so unmarked by any special symptom, and unaccompanied by pain, that it is often only by the increased size of the gland that the patient is induced to seek advice. In some cases, however, this swelling is accompanied by pain of a dull and aching character. In the early stage of the disease the gland may be more or less painful on manipulation, but in a more advanced condition, or in a very chronic case, no local pain will be experienced even on somewhat rough manipulation, and in these examples, on firm pressure, the ordinary testicular sensation will fail to be excited. The general appearance also of the testicle, the subject of this affection, is somewhat peculiar. It is not pyriform or globular, as in hydrocele and many other affections of the gland, but has a peculiar flattened outline from side to side, and a smooth, even surface, unless the disease be associated with some effusion into the tunica vaginalis, when the tumour will naturally assume more the shape of a vaginal hydrocele. But the simple affection is rarely associated with such a complication, and when it is, the fluid, as a rule, is secreted in very small quantities. The epididymis, in exceptional examples, from the extension of the inflammation to its tissue, may be slightly enlarged and thickened, but this never occurs to any great extent.

Shape of gland.

There are, also, seldom any constitutional symptoms worthy of remark, except in cachectic and irritable patients, when the dull aching pain of the part may give rise to some general irritability of the patient's condition, and an anxious expression of countenance.

Pathology.

The pathology of this affection is that of chronic inflammation of any other part, and consists in a more or less general infiltration of the gland, with an organisable or organised material; the inflammatory effusion separating the secreting tubuli, and affecting them in ways determined by the amount of fibrin poured out between them and the amount of pressure to which they are subjected; the inflammatory product in some cases being very generally diffused between the tubuli, while in others it is deposited in irregular masses. When the material poured out is very great, and equally diffused between the meshes of the testis, *i. e.* when the disease is extensive or of long standing, that condition of the gland is probably produced, which is indicated by an utter absence of the natural sensation of the organ on handling, or on firm pressure, and, under such circumstances, there is the greatest anxiety for the subsequent maintenance of the integrity of the organ; though, should the disease make a favorable progress towards recovery, and the inflammatory product be re-absorbed, the pressure will be proportionately removed from the delicate tubuli of the organ, and the natural testicular sensation be restored.

If the inflammatory product soften down, as it will in the delicate and cachectic subject, suppuration will take place, and in proportion to its extent will be the liability to a *hernia testis.*

Again, should this inflammatory product proceed to a more permanent organisation and contract, the delicate tubuli of the testicle will suffer in proportion to the extent of the part involved, and an atrophy of the organ be the result as a consequence.

All these complications are met with in various degrees in practice, and with greater or less frequency, the general condition of the patient having a more important influence in determining the result even than the treatment ; but I may add that there are few affections which are more amenable to good treatment than that now under consideration.

Tubercular disease of testis.

When the disease is remarkably insidious in its advance, slow in its progress, and painless in its character; when the patient is cachectic and irritable, with an anxious countenance, a disposition to a hot skin, and to other symptoms of constitutional irritation; and, more particularly, when the disease ends in suppuration, as in all probability it may when coming on and progressing in the manner just indicated, it is reasonable to believe that the organ is the seat of *tubercular mischief,* and that it disorganises as a result. It must be added, too, that in these cases the tubercular affection is probably of the infiltrating or miliary tubercular form, and not of that crude nature which runs a different course, and to which attention will subsequently be directed.

Gouty inflammation of testis.

In gouty inflammation of the organ, the symptoms, as a rule, are not so chronic as in the class of cases to which we have just alluded. Indeed they may more rationally be described as being of a subacute nature, for though generally coming on slowly, they are manifested by greater local tenderness and pain—the pain being considerably aggravated at certain periods, and most probably at night. The disease has, moreover, a strong tendency towards recovery, and not towards disorganisation of the testis. Besides these symptoms, others indicating a gouty disposition will probably be present such as acidity of stomach, a loaded condition of the urine, and a more or less distinct history of gout. There will also be frequent nocturnal pains of a darting character in the opposite testicle, leading the patient to fear—what is by no means rare—a double attack, and when these pains occur, they are valuable in connection with others as diagnostic symptoms.

Symptoms and Diagnosis of Syphilitic Orchitis.

Syphilitic disease of testis.

That syphilitic inflammatory disease may attack the testicle as any other gland or texture within or without the body is at the present day a well-recognised pathological fact, and the credit of establishing this position is largely due to my colleague, Dr. Wilks. In what way the syphilitic differs from other forms of inflammation is a point worthy of consideration, and, fortunately, the points of difference are neither numerous nor deeply seated. The main one is palpable and apparent, for even to the most casual observer it is readily seen, that in syphilitic inflammations, there is not only an infiltration of the part affected with an organisable or organised material of a dense, firm, and fibrous structure, but a marked tendency of the deposit to undergo fibrous changes. We see this in every tissue and in every stage of the disease. We see it primarily in the almost cartilaginous hardness of the base of the true infecting chancre; we see it in the early constitutional symptoms of syphilis, and in the greater permanency of skin staining in the different eruptions; in the different affections of the mucous membranes in all their parts; in the inflammation of the eye, cellular tissue, periosteum, and bone. The pathologist sees it, moreover, in the varied changes found after death in the internal organs of the syphilitic subject; and the Surgeon sees it, likewise, in the inflammation of the testes. For in the subject of hereditary or acquired syphilis, the testicle may at some period of the disease, and generally at a late one, become the seat of a syphilitic inflammation, which manifests all the peculiarities of this pathological condition. The affection is essentially chronic, as much so as the other forms of chronic orchitis, but is almost invariably confined to the body of the gland, and rarely affects the spermatic duct. It is quite painless in its nature, local and general, the patient bearing free manipulation without flinching, and often thinking little about his disease except from the increased size of the organ. The special sensation of the gland usually disappears at a very early stage of the disease, and there is rarely any constitutional disturbance accompanying its progress. It may or may not be associated with other symptoms of constitutional syphilis, but usually appears alone.

Peculiarity of syphilitic inflammation in general.

Chronic syphilitic inflammation of testis.

Characters.

The disease manifests itself locally in a special manner which claims attention. It usually affects the body of the testis and both testes at different periods of its progress, though rarely at the same time. It is almost always complicated by the presence of a vaginal hydrocele which at times increases to a considerable size, and much more so than in other forms of chronic orchitis. The most characteristic point of all, however, is the remarkable stony induration of the gland and its peculiar, irregular, nodular outline; small fibrous projections being distinctly visible from the body of the gland in some cases, while in others, loose bodies are felt in the tunica vaginalis.

Prognosis.

In the majority of cases this disease terminates by resolution, and apparently leaves the gland intact, although in many, a gradual wasting of the testicle is the result, which ends in atrophy, and as a consequence, in sterility. In exceptional cases, suppuration with or without hernia testis may take place. The disease, too, when apparently cured, has a remarkable disposition to return on the slightest provocation.

Treatment of chronic orchitis.

Mercury.

The Treatment of Chronic Orchitis.—There are few affections more amenable to treatment than chronic orchitis, especially when taken early; and there are none which better prove the value of pressure and mercurials in procuring the absorption and disintegration of inflammatory products. In the common as well as in the syphilitic orchitis this statement holds good. In a healthy subject with good powers and an unbroken constitution, any form of mercurial may be administered such as blue pill in four-grain doses, or the perchloride; or mercurial inunction, with the oleate of mercury, is likewise beneficial. The object of the Surgeon is neither to salivate nor to bring the patient rapidly under the influence of the remedy, but rather to procure a lengthened and equal action of the drug upon the local disease; the dose therefore should be carefully regulated. In my hands, the iodide of mercury given in one-grain doses, with five grains of Dover's powder twice a day, or the mercurial suppository has proved eminently beneficial, the testicle being well strapped up by common soap plaster. (See Fig. 383.) In a more cachectic patient in whom mercury may still be tolerated, the same treatment may be employed, though in smaller doses; and in others, the mercurial may be locally applied in the form of an ointment, or as an oleate dissolved in oleic acid in the proportion of five per cent. During this time tonics, such as quinine and iron, may be administered, and good living and fresh air enjoined.

Mercury and pressure.

Iodide of potassium.

In certain examples, however, occurring in cachectic patients, it may not be desirable to administer mercurials in any shape; under such circumstances, iodine may be substituted in the form of the iodide of potassium in three- or four-grain doses, gradually increased to ten or twelve, combined with half-drachm doses of the syrup of the iodide of iron in infusion of quassia, three times a day. Locally, strapping, or rather pressure, should still be enforced. In hospital practice this treatment has been of great value; by it, steadily persevered in for six or eight weeks, even the worst of cases may be expected to yield, the organ gradually becoming softer and more natural in sensation and shape, and at last resuming its normal condition.

Colchicum.

In the *gouty* form of orchitis, which can be recognised or suspected by the symptoms already quoted, the administration of colchicum is very beneficial. It should be given in small doses, and continued for several weeks. The acetic extract in half-grain doses, with Dover's powder, is the best form, and with it a cure may generally be guaranteed. This form of disease is easily reduced when early recognised. It is more liable, however, than other forms to relapses, but less so to disorganisation and subsequent atrophy.

If there be sudden accessions of pain in the part, with other evidences of some fresh inflammatory attack, the application of a few leeches with hot fomentations is very serviceable, but these conditions are uncommon.

Attend to hydrocele.

When vaginal hydrocele co-exists with the inflamed gland—a frequent complication of the syphilitic variety—it is a good practice to draw off the fluid, to enable the Surgeon to apply his pressure with more certainty and better effect. It is of no use to attempt to cure the hydrocele itself, as it must be remembered that the hydrocele is the direct consequence of the diseased testis, and that it is of little use to treat the effect of a diseased condition, and not its cause. Remove the latter, and the former will probably disappear; cure the orchitis, and the hydrocele will generally depart.

I have the records of a case which passed under my care for treatment, where, by some oversight, this attempt had been made, and the hydrocele was tapped and injected with iodine on three different occasions, without success. Under the subsequent treatment the chronic orchitis disappeared, and with it the hydrocele.

Rest.

It is not always desirable, nor is it possible in a large proportion of cases, to keep the patient absolutely at rest during the process of treatment. In some it is advisable to do so as much as possible, particularly when the patient experiences more pain and inconvenience when walking or moving about, but, in the majority of cases, it is sufficient to keep the parts well supported.

Prognosis of chronic orchitis.

In the consideration of the treatment of chronic orchitis it has been stated that a good recovery may generally be secured by the means which have been suggested, when the disease has been taken in hand at an early period of its existence; that is, when not more than five or six weeks have been allowed to elapse. But in case of longer standing, the prognosis is not so favorable, either as regards the removal of the disease, or the subsequent integrity of the part as a seminal gland. These remarks apply more particularly to the syphilitic form of the affection; for, if of long standing, the fibrinous matter has generally become too well organised for future absorption, and when this is the case the subsequent contraction of the organised product will almost to a certainty go on to the destruction of the seminiferous tubuli, and an atrophy of the gland. In Guy's Hospital Museum are several admirable specimens exhibiting this result.

Again, in certain examples of chronic orchitis, whether syphilitic or otherwise, suppuration and disintegration of the gland structure will take place. This termination may be suspected when the disease is of a very torpid character, the pain of a constant aching kind, and when all treatment fails to influence its course.

Pus depôts to be opened.

When pus has formed, its early evacuation is the best practice, as a clean incision or puncture into the part often prevents that destruction of the glandular structure and its fibrous covering, which usually precedes that troublesome affection, hernia testis.

On Tubercular Disease of the Testicle.

On tubercular disease of testis.

Tubercular disease of the testicle may attack any part of the organ —that is, either the seminal gland or its duct—or it may affect these parts separately or together. It may show itself either in the form of an infiltration of the so-called miliary tubercles, or in the more distinct and usual condition of the yellow, cheesy, unorganisable material described as crude tubercle. When it appears in the form of miliary tubercle it is not characterised by any very definite symptoms; indeed the infiltration of a gland with those small, grey, miliary bodies seldom makes itself known by any outward visible signs, and their presence should be suspected only when a rapid disorganisation of the part takes place, after an attack of acute or chronic inflammation. Organs thus infiltrated have no power of resisting the inflammatory process, and,

When in form of miliary tubercle.

whether it be a lung or a testicle which is the seat of this affection, active breaking up of tissue with suppuration generally ensues. I shall exclude from present consideration those interesting cases, remembering that while pathologically they are clearly to be recognised, practically their presence can only be suspected when the result to which I have already alluded takes place.

When in form of crude tubercle.

Symptoms.

The other form of tubercular testis is characterised by more special symptoms and local conditions. It may involve, as already stated, either the body of the gland or the epididymis, but, doubtless, the latter is the more frequently diseased. It is generally discovered accidentally by the patient, and frequently not until some secondary change in the structure is about to show itself. It appears primarily as an indolent, painless enlargement of the epididymis, and is described usually by the patient as a lump in the testicle, this lump appearing generally at the upper part. This symptom, in all probability, is the only one to which attention can be drawn, and the Surgeon will recognise it at once on manipulation, for the tubercular matter will feel as if some foreign body, as a pea, bean, or nut, had been placed between the convolutions of the epididymis, or in the substance of the gland. The gland is not painful on pressure, nor in its inactive stage does the disease seem to cause any injurious influence on the organ, which is otherwise natural in its sensation and function.

In other cases, the disease will appear as a general infiltration of the part involved, and should this be the epididymis, it will be enlarged, indurated, and nodular, painless perhaps, and inactive, the body of the testis apparently sound, resting on the concavity of the affected portion. If the body of the gland be the part affected, like symptoms will be present, although the enlargement will show itself as a uniform or nodulated expansion of the secreting structure; the epididymis, or seminal duct, being quite distinct.

May be inactive.

May soften down.

May inflame and suppurate.

This inactivity of the disease, however, does not remain always, though it may last months, or even years—but the time will come, when the tubercular matter, in all probability, will soften down, and thus excite some increased action in the parts around. It may be that this increased action in the part will first draw the patient's attention to his affection, when the history of some previous thickening of the organ will for the first time be obtained. When inflammatory symptoms are once developed, the disease will certainly make rapid progress, and disintegration of this unorganisable tubercular matter accompanied by suppuration will speedily follow.

Where affecting epididymitis.

In tubercular epididymitis—for such this disease may be named—local suppuration will soon appear, with the discharge of ill-formed pus and débris, as a curdy, friable, and granular material; and after this, sinuses are apt to form, which may go on discharging for a period, depending on the extent of the disease, and the amount of foreign material existing to disintegrate and soften.

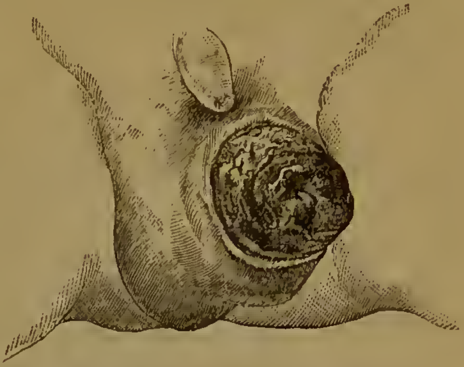
Where affecting testicle.

If the body of the testicle be the part implicated, the same gradual softening and suppuration will take place, but too often it will be followed by the formation of the hernia testis to which allusion has been already made. It is not, moreover, in every case of this disease of the testis that disintegration of the tubercular material is to be expected, with its accompanying suppuration and abscess; for in many examples, no such result can be found, this tubercular matter undergoing a gradual change, and showing itself after death as an earthy concretion. The same changes take place in the testicle as is seen in the absorbent glands, the lungs, and other parts.

Tubercular disease of the testis may occur at any age, but is more common in adult life. The best example that I have seen was in a child aged two years, whose testicle I excised for disease of six months' standing, which had progressed very slowly and acquired a large size before suppuration occurred. Convalescence followed the operation. (Fig. 380.) The whole organ, with the epididymis, was nearly filled with scrofulous deposit. It is in the testicle that we have the best opportunity of examining the true tubercular disease in its different stages, and of watching the various form of its deposition, its changes, and decay.

May occur at any age.

FIG. 380.



Hernia of the testicle following tubercular disease, removed from infant, æt. 2.

Treatment of Tubercular Disease of the Testicle.—When tubercular material has been once deposited in a testicle as in any other tissue, there are no recognised means by which the absorption of this material can be procured. It is true that it may remain in an inactive or passive condition for an indefinite period, and finally, by undergoing an earthy degeneration, cease to trouble; nevertheless, it will still exist, ready as it were, on the least disturbance, to light up some inflammatory action in the tissues around, and to give rise to any or all of the various conditions just described.

Treatment of tubercular testicle.

Looking also upon the deposition of tubercle in a testicle as only one of the local manifestations of that general condition described as tuberculosis, it is clear, that the principles of treatment should be of a general character to improve the health and revive the powers of the patient by tonics, good living, good air, regular habits, and, what is of great importance, total abstinence from sexual excitement or gratification. Indeed the parts should be maintained as much as possible in a quiet condition, and for this purpose, cold sponging night and morning is of some service.

Attention to general health.

Rest.

When inflammatory symptoms make their appearance, they will generally run their course in spite of treatment; for, as already shown, they are usually caused by the breaking down of the tubercular deposit, which may be looked upon as one of nature's means for its elimination; indeed, until this material has been discharged, the subsidence of inflammatory symptoms is not usually to be expected; fomentations in this stage and the application of water dressing to the part are, therefore, suitable, and the testes should be supported in a suspensory band-

During inflammation.

During suppuration.

age. When suppuration is nigh at hand or has manifested itself, it is good practice to open the abscess freely, with a lancet, as it saves time and pain to the patient and often prevents the formation of the sinuses which prove so troublesome. During all this time the health of the patient must be attended to by ordinary measures.

When testis large and disorganised.

When the gland has attained a large size and is evidently destroyed by abscesses and disintegration of the infiltrating material, it may be excised, and more particularly if hernia testis has appeared and the disorganised testis is a source of trouble and weakness to an enfeebled patient.

On hernia testis, "benign fungus."

On Hernia Testis.

Character.

Causes.

Condition of parts.

This affection, which has been variously described as "granular swelling," and "benign fungus of the testis," has also more correctly been called "hernia testis," for it is essentially a gradual protrusion of the substance of the gland through a rupture or ulceration of its fibrous envelope, the tunica albuginea. It may follow upon suppuration of the body of the gland the result of an injury, or of an acute or chronic orchitis, or from the softening down of tubercular deposit. It seems to be the result of pressure produced by the natural elasticity of the fibrous tunica albuginea; the testicle, as it were, being gradually squeezed out of its capsule and everted, the mass being eventually increased by the free granulations which spring up on its surface. The whole organ, or only a portion of it, may thus be extruded from its natural position, the extent varying according to the amount of disease and the size of the opening in the tunica albuginea and integuments. It must not be supposed, however, that this hernia testis is the necessary consequence of suppuration or of disorganisation of any portion of the gland, for such is not the case; indeed, in the majority of instances of suppuration, it does not occur.

Diagnosis.

The diagnosis is not difficult, and the disease having been once seen, can be subsequently readily recognised. It is a peculiar fungating-looking growth with everted edges and a sinus in its centre generally secreting pus. It is of variable extent, and presents a more or less irregular surface and a pedunculated base, the pedicle passing through an opening in the scrotum to the remains of the testicle. The margin of the opening in the scrotum is generally free, although in some cases adherent to the growth. It may be slightly indurated from inflammatory thickening, but will never present the same aspect as a cancerous growth, for which, however, this affection may be mistaken; the term "fungous testis" having doubtless been the means of encouraging the great error of regarding this simple disease as malignant. The natural sensation of the gland remains, however, in these cases, and will be readily excited by manipulation, whereas in cancerous disease no such natural sensation exists; in doubtful cases this point is one of primary importance.

Treatment of hernia testis.

Treatment of Hernia Testis.—It may be safely stated that the majority of cases of hernia testis can be successfully treated by other less severe measures than castration, although this operation has been very generally performed for this affection. In exceptional instances it may be demanded, and I have the records of many in which it has been successfully performed. The Surgeon's object, it may be briefly stated, is to restore the extruded testicle to its natural place, which may frequently be done by simple pressure applied by fixing a good firm pad over the surface of the growth, and drawing the margin of the ulcerated scrotum well forward, fixing the whole in position by strapping. In other cases, where the granulations are very exuberant, caustics may be used to hasten their destruction; among the best is the red oxide of mercury; pressure should be well maintained during its use. All minor cases, and many of the severe, may certainly be cured by these means, if steadily pursued and well applied. In the more obstinate and severe examples other measures must be adopted. The excision of the surface of the growth was formerly employed, and is occasionally resorted to in the present day, but the practice, at best, is a very doubtful one, for in the majority of cases to which it is applicable it would be tantamount to castration, as the fungating mass is, as a rule, composed of the everted tubules of the testis, covered with granulations, and, consequently, by this measure, the tubules would be cut off and the gland destroyed.

Pressure.

Red oxide of mercury caustics.

Excision deprecated.

Mr. Syme described, in the 'London and Edinburgh Monthly Journal' for January, 1845, a plan of treatment which in these cases is very serviceable. The operation consists in the elevation of the margin of the scrotum from the protruding mass, the reduction of the hernia testis within the scrotum, and the retention of the part in its natural position by stitching together the margins of the wound, careful bandaging and strapping being also required in the treatment of these cases. The granulating organ becomes attached to the inner surface of the scrotum, and a healthy action is subsequently restored. It is almost needless to add that a local and constitutional treatment for the original affection of the testis should at the same time be maintained.

Syme's operation.

On Cystic Disease of the Testicle.

There is no affection of the testicle on the nature of which there has been a greater difference of opinion than cystic disease, and although modern pathologists have devoted considerable attention to its investigation, the subject has not yet been brought out of its obscurity, and made plain to the profession.

On cystic disease of testis.

Sir A. Cooper, one of its original inquirers, looked upon it as a distinct disease of the secreting *tubuli* of the organ, and upon his authority this view was for a time generally received. More recently, Mr. Curling's researches have tended to prove it to be an affection of the *ducts* of the testicle, and not of its secreting tubuli. "Why they alone," says Mr. Curling, "are subject to the morbid change, I admit my inability to explain." Whether this opinion be correct or not will be one of the subjects for present consideration; since I am disposed to think that it is not quite consistent with observed facts, although there can be no doubt that the rete testis appears to be the seat of the disease in certain cases, while in exceptional examples, cystic disease is undoubtedly formed independent of this structure.

Curling's views.

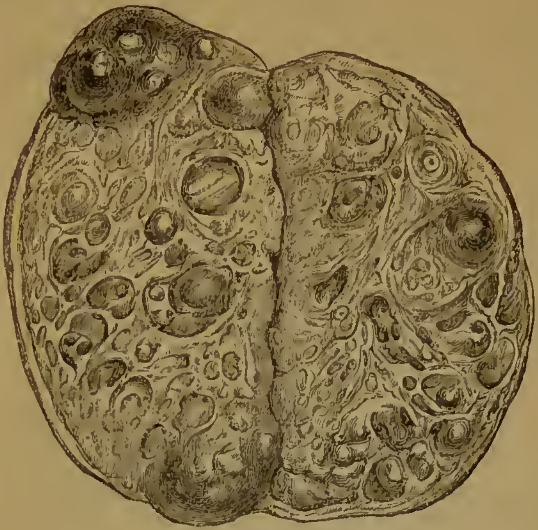
It has been my privilege to examine many examples of this rare affection with some care, and I entirely concur in the main with

Nature of the disease.

Mr. Curling's conclusions, although I am not so sure of the special seat of the disease as he appears to be. It is doubtless made up of cysts, which are multilocular, and of sizes varying from that of a mustard seed to a moderate-sized nut. (Fig. 381.) These cysts are filled with a thin, serous, blood-stained, or glairy fluid, and at times with more or less pedunculated intra-cystic growths made up of a delicate cellular structure, or of a distinct cell tissue. These cysts appear embedded in a fibrous stroma of different degrees of consistency and density. The fibrous elements in some are much more numerous than they are in others; whilst in some, again, it will be of a more delicate nature, and more allied to the fibre structure found in the softer sarcomatous growths of other parts. In certain examples, the cysts are clearly made up of dilated tubes with pouches at their extremities, or, as lateral dilatations—these tubes containing granular matter being occasionally lined, as Mr. Curling was the first to observe, with tesselated epithelium. I have failed, however, to find this in all the cases I have examined, and am disposed to look upon the presence of this tesselated epithelium as specially characterising a certain growth. Spermatozoa are invariably absent in the cysts or tubes of this affection, while cartilage or bone elements will almost always be found to exist either as small isolated patches or as filling the cyst, in which case the growth might be described as an enchondromatous tumour; the cartilage is deposited in separate masses, and these masses are divided by a fibrous stroma. The true secreting portion of the testicle will often be found pushed up into some corner of the tumour, spread out over the cystic mass, or distributed between the cysts themselves, the tumour being invariably encysted in its own capsule; in rare cases, tumours of this nature will be found upon the cord and body of the testicle. The above facts, lead me to conclude that the majority of these are new growths following the great law which governs the development of all tumours, by taking on the likeness of the part in which they are developed, and that they are more or less built up as is the structure of the normal gland. The testis being essentially a tubular organ, all morbid growths developed in or near it have a tendency to assume a tubular or cystic character, this character varying in extent in different cases; the cystic

Varieties in the structure.

Fig. 381.



Cystic disease of the testicle.

or tubular and fibrous or sarcomatous structure being found in different degrees of perfection and quantity in different cases.

Fibrous and fibro-plastic tumours.

We may thus find in the testicle, a tumour presenting all the elements of the fibrous or sarcomatous tumour without cysts, whilst in another, in which the cystic formation more or less predominates, the same elements will exist in smaller proportions; and, in the majority of these examples, the true structure of the testicle will be found spread out in a variable extent over the special capsule of the new growth. In other cases, the new growth will be altogether free from any connection with the testis itself, and be found growing from the cord. All these separate kinds of tumours, examples of which may be seen in Guy's Museum, appear to me merely modifications of one kind of growth—the simple, or perhaps more correctly, adenoid growth of the testis.

Analogy between tumours of breast and testicles.

We thus see a close analogy between these tumours of the testis and those of the mammary gland, as well as of the ovary, and find in all the simple adenoid tumour partaking more or less of the nature of the gland in which it is developed; and a true cystic disease of the gland itself, the latter being evidently a special affection of the tubes and ducts of the mammary gland or testis, and not of the secreting structure. In both organs they are new growths simulating, more or less correctly, the anatomical structure of the true gland.

Symptoms and Diagnosis.

Symptoms of cystic disease of testis.

Having described the special pathology of this disease, I pass on to consider its clinical aspect, as well as to point out the symptoms which indicate its presence, and help the formation of a correct diagnosis. In doing so I must premise, that the several forms of this cystic disease are to be recognised more by negative than by positive signs, since they appear usually as painless enlargements of the organ, are of slow growth, and unaccompanied by any such symptoms as attract attention—the patient, indeed, seldom seeking advice until the organ has become troublesome from its size, or the dragging pain in the loin, which always exists when the testicle has become large and heavy from any cause, excites anxiety. The testis soon loses its natural shape, and assumes more the oval or pyriform outline of a vaginal hydrocele or hæmotocele. It will probably have a smooth and equal surface, and be indistinctly fluctuating, though not translucent; while its natural sensation experienced on manipulation will most likely have disappeared at a very early age of the disease. The general health of the patient may probably be good, and there will be no evidence of any secondary glandular affection.

Differential diagnosis.

From hydrocele and hæmatocele the disease may generally be recognised by the history of the case, the opacity of the tumour, and the loss of the natural testicular sensation. When doubt exists, an exploratory puncture by the trocar and canula will decide the point, for in cystic disease a little bloody and glairy fluid will alone escape.

From the inflammatory affections it may be diagnosed by the difference in the shape and feel of the tumour; the flattened compressed form of the organ, with its hard and nodulated feel, as met with in the different forms of orchitis, contrasting with the more or less globular or pyriform shape, smooth outline, and elastic feel, without the peculiar testicular sensation present in cystic disease. The inflammatory affections are also often associated with a hydrocele, the cystic rarely. In the former, also, both organs are generally affected sooner or later; while in the latter, the disease only attacks one. Medical treatment does not appear to have any influence in arresting the development of the cystic, whilst in the inflammatory disease a good recovery may generally be secured by the use of proper remedies.

Treatment of Cystic Disease.

Treatment of cystic disease.

There is but one remedy, which is the removal of the diseased organ. No drugs seem to have the slightest effect in diminishing its size or arresting its growth. Excision, therefore, should be performed, the operation being, as a rule, most successful.

On Cancer of the Testicle.

On cancer of the testis.

The testicle, like all glands, may become the seat of cancerous disease, both of the carcinoma-fibrosum or hard cancer, and of the carcinoma-medullare or soft cancer. It is rare, however, for the hard cancer to attack the testis, the majority of examples being of the soft or encephaloid form. For one example of the hard cancer it is probable that at least twenty of the soft are met with in practice. In the different museums specimens of the former kind may be seen, and at Guy's several exist.

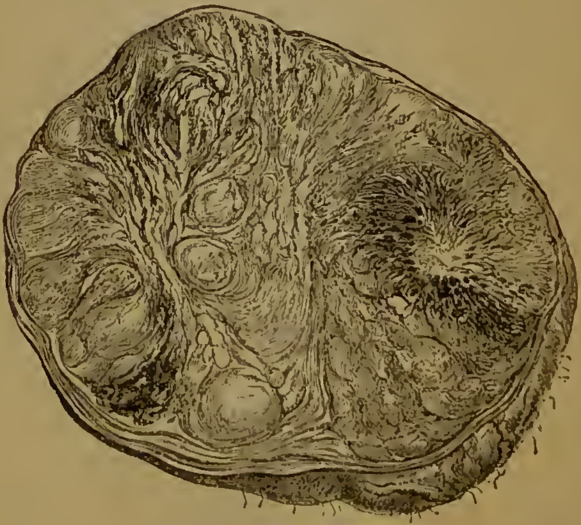
Tuberous form.

Infiltrating form.

Cancer may also attack this organ in two forms, either as the tuberous or the infiltrating cancer. In the former, the disease appears either as an isolated growth, or as several distinct tumours separating the parts and then eventually coalescing into one mass; in the latter, it appears from the beginning as the infiltrating kind, the cancerous elements being more equally distributed between the tubes and ducts of the true secreting gland tissue.

The malignant affections of the organ, as the simple, are accompanied by the development of cysts, and these, in the malignant cases, are filled with cancerous matter in lieu of the glairy mucous or fibro-

FIG. 382.



Cancer of the testicle.

cellular intra-cystic growths which are found in the sarcomatous, adenoid, or cystic diseases. In rare examples both conditions seem to co-exist in the same organ; simple cysts, with the clear or blood-stained glairy fluid, being found in one portion, whilst in others, these cysts are filled with cancerous material, and in a third, enchondromatous masses may at times be present (Fig. 382).

The part of the organ generally attacked is the body of the gland, although the epididymis may be the seat of the disease; but when the latter is involved, as a rule it is an extension of the disease from the body of the tumour. Rare examples, however, exist which illustrate a primary affection of the epididymis.

Age.

Cancer may attack the testis of the old as well as of the young, and I have the records of cases occurring in men aged 56 and 62 respectively. Instances of this disease attacking infants, even so young as seven months, have likewise been recorded by different authors, and I have excised a cancerous testicle from a boy only two years old. The majority of cases occur, however, in young adult life, from 25 to 40 years of age, as is indicated by the following facts.

Statistics of age.

I possess the records of twenty-five cases, which I have added below to the fifty-one examples originally tabulated by Mr. Harvey Ludlow, in his Jacksonian prize essay. The results are as follows:

Before the age of 5 . . .	6 cases.
From 15 to 20 years . . .	2 „
„ 22 to 30 „ . . .	17 „
„ 31 to 40 „ . . .	31 „
„ 41 to 50 „ . . .	11 „
„ 51 to 70 „ . . .	9 „
	76

Out of my 25 cases the disease in 20 had been growing for one year or less, and in the remaining 5 cases two were of three years', two of four, and one of five years' standing.

It is rare, if not unknown, for both testicles to be the seat of cancer at the same time. I am not aware of any such example being on record. In 16 out of the 25 cases before me, the right organ was attacked, and in 9 the left. Mal-placed testicles appear to be particularly prone to this disease.

Growth.

Character.

Cancer of the testicle may come on as insidiously as the simple cystic disease, but in general, its growth is more rapid. It makes its appearance as a gradual enlargement of the body of the organ, seldom attended by pain. There is also an early loss on pressure or manipulation of the special testicular sensation. The outline of the tumour is smooth, semi-elastic, and fluctuating, but as the disease progresses, its surface may become somewhat uneven or irregularly bossy, the tumour being harder in some parts than in others, the softer parts projecting. In the carcinoma fibrosum, however, the whole tumour is hard, and at times nodular. The tumour is opaque from the beginning, and rarely, if ever, associated with hydrocele, and when so, it is by chance, the one affection having no direct relation to the other. In this respect cancer differs from inflammation of the organ, which is very frequently complicated by the presence of hydrocele.

Progress.

The disease rarely extends beyond its fibrous covering, or involves the scrotum; and for a bleeding fungus to form, the tumour must be very large. As the disease progresses the health of the patient may suffer, and a general aspect indicative of exhaustion and some wasting disease appear, although it is not till a late period of this affection that any such symptoms are to be expected. When lumbar pain or a constant aching exists, a suspicion of enlarged lumbar glands should be excited, and, in certain examples, a chain of enlarged glands may be felt extending upwards along the psoas muscle.

Enlarged inguinal glands.

The inguinal glands are occasionally enlarged from infiltration, though it is believed by some that this complication does not appear till the scrotum is involved in the disease. This, however, is certainly not the case, for large inguinal glands may appear at an early stage of the affection.

Diagnosis of cancer of testis.

The diagnosis of this disease is by no means easy, particularly in its early stage, indeed, in many instances, it is almost impossible to be certain of its nature. It is the size of the organ which generally first draws the attention of the patient to the part; and the pain and inconvenience caused by its weight which prompt him to seek advice.

From hydrocele and hæmatocele.

The history of the case and the absence of translucency will prevent its being mistaken for a hydrocele. Hæmatocele, as a rule, has a distinct and special history of its own, and the fact that the testis may be made out to exist in some portion of the tumour is a material aid to the Surgeon in forming a correct opinion as to the nature of the case.

From testitis.

The tenderness of the organ, the nature of the pain, and the shape of the swelling, are sufficient to indicate the inflammatory affection, and when fluid exists, the diagnosis is rendered more plain, since a vaginal hydrocele rarely co-exists with any other disease than the inflammatory, except to a very slight extent.

From cystic disease.

The simple cystic disease is of slower growth than the cancerous, and generally firmer to the feel; when punctured, it yields also a glairy fluid unlike the creamy material which comes away from the cancerous disease. The subject of diagnosis of all these growths will, however, be discussed hereafter.

Treatment.

Treatment.—The only treatment which gives any comfort to the patient is excision of the organ, and this should be done as early as the diagnosis can be made, for there is then less chance of the glands in the loin becoming involved. The general health must also be attended to with great care at the same time.

On the Diagnosis of Scrotal Tumours.

General summary of diagnosis of scrotal tumours.

I propose now to consider the subject of the diagnosis of scrotal tumours as a whole, to describe the train of thought which passes through the Surgeon's mind when examining such a case with diagnostic intentions, and to point out the special symptoms or their combination, as they tend to indicate the presence of any special affection. In doing this, I believe that a near approximation to truth may generally be made, when the history of the case and its special symptoms are carefully weighed. Great difficulty may occasionally be experienced in any given case, or it may be beyond our power to form any positive opinion upon its nature, but I am not disposed, on that account, to place among impossibilities the diagnosis of a scrotal tumour. There are gradations of probability in all our conclusions as to the diagnosis of any disease, and a certainty untainted by fallacy or doubt is rarely obtained; but, I take it, we are as often correct in our judgment of a scrotal tumour as of any other affection. To aid the student in this task the following table has been drawn up. (Pp. 234, 235.)

Is it a hernia?

The first point the Surgeon has to decide, on being consulted as to the nature of a scrotal tumour has reference to the question of hernia. Is the tumour connected with the testicle? or has it passed down the direction of the cord from the abdominal cavity? If the Surgeon is able to isolate the growth at its neck from the abdomidal cavity by the thumb and finger, the question is at once decided, for almost all scrotal tumours can be so isolated, it being quite exceptional for any to pass up the cord so far as the internal ring. Rare cases of vaginal hydrocele, or hæmatocele, however, in which the tunica vaginalis is open up to the internal ring, form an exception.

It being determined that the swelling is not a hernia, the nature of the tumour next claims attention.

Is it a hydrocele or hæmatocele.

Is it a hydrocele or hæmatocele? Is it the product of inflammation or of tubercular disease? Is it a new growth altogether, and if so, is it innocent in its nature or malignant?

Translucent tumours.

If the tumour prove translucent by transmitted light, the existence of a hydrocele is fairly decided; but, then, is it an ordinary vaginal hydrocele, or encysted? Should the tumour be large, even, and pyriform, and the testis be found at the posterior part of the tumour, either by means of manipulation or by the opacity displayed at one spot on transmitting light, vaginal hydrocele may be suspected; but should the testis exist in front or at one side, and the tumour have been of very slow growth, small, and more or less globular or evidently multilocular, a cystic hydrocele may probably be diagnosed. The tapping of the tumour will, however, settle the diagnosis; for in vaginal hydrocele the fluid will be more or less straw-coloured and albuminous, while in the encysted it will be watery, non-albuminous, and occasionally, but not always, opalescent, and when opalescent containing, on microscopical examination, granules and spermatozoa.

In examples of old hydrocele, however, the tumour may be opaque, and, under such circumstances, difficulties may be experienced; yet the history of these cases will tend to throw much light upon the point, for to a certainty it will reveal a disease of very long standing; the tumour will be probably painless and fluctuating, and the testis made out to be in its usual position at the posterior part of the sac. When a doubt exists a puncture with an exploring trocar and canula will decide the question, as in these cases fluid will be drawn off of a dark colour, loaded with cholesterine.

Tumours not translucent.

We will now pass on to the consideration of tumours which are not translucent and not hydrocele, and it is here that the Surgeon experiences true difficulty in his diagnosis, as almost all the diseases of the testis are insidious in their growth, and chiefly painless in their development. The hæmatocele, except in rare examples, usually follows upon some strain or injury, increasing with tolerable rapidity up to a certain point, and accompanied by pain, which soon subsides. It then becomes stationary as to size, and remains torpid for a variable period, when pain reappears, with other signs of inflammation. The presence of the testis is also to be made out by manipulation towards the posterior part of the organ. The surface of the tumour is

Hæmatocele.

TABLE OF DIAGNOSIS OF CHRONIC

Symptoms.	Hydrocele.	Hæmatocele.	Chronic orchitis.
Condition of tumour	Tense, usually transparent, fluctuating	Tense and elastic; *not* transparent; *obscure* fluctuation	Firm, and not elastic; *not* transparent; not fluctuating, unless complicated with hydrocele
Outline	Smooth and uniform	Smooth and uniform	Smooth and compressed laterally
Position of testis	Posteriorly in *vaginal*. Anteriorly at side, or below in *encysted*	Posteriorly	Evidently an enlarged testis
Testicular sensation	Present on manipulation	Present on manipulation	Present at first; absent after long existence of disease
Rapidity of Growth.	Gradual, most so in *encysted*	As a rule sudden, and after accident, at times spontaneous and gradual	Slow
Size	To great dimensions in *vaginal; moderate* in *encysted*	Moderate	Rarely more than 3 or 4 times natural size
Form	Pyriform or oval in *vaginal*; globular in *encysted*	Pyriform, or oval	Oval, with flattened sides
Pain	Very slight, if any, except when complicated with inflamed testis, and in acute hydrocele. Not increased on pressure	Painful at first, and at a later stage; not so during the intermediate	Dull pain, increased on pressure, except in very chronic disease
Manipular indications.	Like fluid, vibration on palpation	Firm and solid	Firm and solid, unless associated with hydrocele
Seat of its commencement	In *vaginal*, at the lower part of the tumour. In *encysted*, at the upper	—	Evidently in body of gland
Cause	No recognised cause.	An injury or strain, rarely spontaneous	Injury; or idiopathic
Progress	Has a tendency to remain tranquil, and not to inflame, unless injured	Has tendency to inflame and suppurate, and not to remain tranquil for long	Slow growth; rarely, but at times ends in suppuration
Condition of cord	Free and healthy	Healthy	Often full and tender on manipulation
Results of tapping, exploratory or otherwise	Straw - coloured, serous fluid in *vaginal;* limpid, opalescent in *encysted*	Blood fresh, or broken up with pus	—
Condition of inguinal and abdominal glands	Free and healthy	Healthy	Healthy
Complications	Inflamed testicle	None, unless hydrocele, or injured testicle	Occasionally with hydrocele
Organs involved	Occasionally double	Never double	Generally both organs, either separately or together.

DISEASE OF THE TESTICLES.

Syphilitic orchitis.	Tubercular disease.	Cystic, or adenoid disease.	Carcinomatous disease.
Very solid, but not elastic or transparent unless complicated with hydrocele, which is very general	Indolent indurations in body of gland or epididymis, like foreign bodies. Towards the end, these bodies soften and excite suppuration	Firm and elastic; insidious enlargement of gland; not translucent; indistinct fluctuation	A tense and firm enlargement of body of testis; not translucent. Indistinct fluctuation towards later stage; bossy outline; parts softer than others
Irregularly nodular and very hard	The epididymis the most frequently involved	Generally regular, smooth, and elastic; rarely bossy	
In tumour	In natural position, often half surrounded by epididymis as a half crescent	In tumour	In tumour.
Absent altogether, except in very early stage; returns also towards convalescence	Present	Present at first, but soon lost	Soon disappears.
Slow in the extreme, often hardly noticed	Slow at first; rapid afterwards, when softening and inflamed	*Unequal;* slow at first, more rapid afterwards	Rapid, as a rule; slow only in the carcinoma fibrosum, which is very rare.
Moderate	Moderate	Rarely, but sometimes very large	Sometimes very large.
Irregularly oval and lumpy	Lumpy; uneven in all its stages	Oval, with flattened sides. Smooth at first, subsequently bossy	Globular or pyriform. Smooth at first, subsequently lumpy, softest at these points.
Very slight, allows rough handling Towards end of disease, on recovery, pain on pressure returns	Very slight pain or tenderness, except when pressed hard or inflamed	Slight, when present; generally painless, even on manipulation	Very slight, even on free manipulation.
Very hard and irregular outline. Often hydrocele, with small fibrous bodies in tunica albuginea.	At *first* as if foreign bodies existed in the parts, lumpy. At *last* soft before suppuration	Firm and elastic, more so in one spot than another	Firm, but elastic; softer on the bosses, when present.
Always in body of gland.	Generally in epididymis; occasionally in body of gland	In body of gland	Body of gland.
Constitutional syphilis, hereditary or acquired	Tuberculosis.	Unknown.	Unknown; occasionally from injury.
Essentially chronic; rarely terminates by suppuration	Very indolent and insidious; tends to inflame and suppurate after an uncertain period	Unequal; never inflamed.	Rapid as a rule; rarely slow.
Free	Healthy	Healthy	Full; veins enlarged.
—	—	*Mucoid fluid,* more or less blood-stained	*Blood* or *creamy fluid,* with characteristic cell-growth on microscopical examination.
Generally indurated	Generally indurated	Rarely involved	Generally involved.
Hydrocele, almost always. Other syphilitic affections	Rarely with hydrocele. Tubercular disease in other parts of body	Rarely with hydrocele	Cancer in other parts; rarely with hydrocele.
Often both organs	Both organs, as a rule, involved	Always single	Single as a rule.

always smooth, more or less oval or pyriform, and semi-elastic or fluctuating.

Inflammatory affections of testis.

The inflammatory affections of the testis have a peculiar shape, being laterally flattened, and are usually accompanied at some period of their course with tenderness and pain, as well as often associated with fluid in the tunica vaginalis. In the syphilitic inflammation this fluid is often copious. Both organs are also generally involved, either together or at different times. The tumour is usually somewhat tender to the touch, and has a firm fibrous feel, unlike the semi-elastic and half fluctuating sensations afforded by cystic or carcinomatous disease. In very chronic cases the testis may, however, be perfectly painless and allow of any amount of manipulation without distress, the natural testicular sensation in fact having disappeared. In syphilitic disease, the surface of the tumour will probably be irregular, with firm fibrous outgrowths in different parts, and in the tunica albuginea.

Tubercular disease.

In the tubercular affection of the epididymis or testis there should not be any difficulty in the diagnosis, for the tubercular deposit, as a rule, takes place unaccompanied by pain or any symptom beyond that produced by its deposition. When deposited in masses—its usual form—it feels like some foreign body introduced into the substance of the gland or of the epididymis; and is at first quite painless and unproductive of any symptoms, these symptoms only appear when the material begins to soften down, and excite some inflammatory action in the parts around. The tubercular material may be deposited in one or more masses, these subsequently, perhaps, coalescing into an irregular induration. When suppuration takes place, the diagnosis is complete.

Cystic disease.

The cystic or simple tumours of the testis are painless throughout the whole course of their growth, and can be recognise by purely negative symptoms. They attract the patient's observation only from their size, can be handled without exciting pain, and do not usually give even the natural sensation of the organ upon pressure. They are slow in their progress, uniform in their outline, and more or less globular; are always confined to one gland; are rarely accompanied with fluid in the tunica vaginalis; and on being punctured, emit only a more or less blood-stained glairy mucus.

Cancerous disease.

The cancerous tumours of the organ are more rapid in their development than the cystic, a year's growth as a rule, giving a large tumour. They are likewise painless, and readily allow of free manipulation. The natural sensation of the organ also soon disappears. They are unaccompanied with a hydrocele, and also involve only one organ. They have a more elastic and fluctuating feel than the cystic or inflammatory enlargements, and when their outline is unequal or bossy, the projection is generally softer than the other portion of the tumour. An exploring needle, or trocar and canula, rarely, if ever, reveals the mucoid fluid so characteristic of the cystic or simple affections, but usually lets out blood or the thin creamy fluid so characteristic of a cancer. In the preceding table, the chief points of difference in the several chronic affections of the testicles are clearly shown. (See Table, pp. 234, 235.)

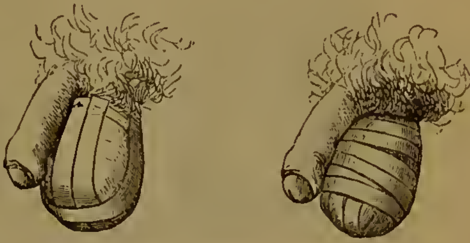
Castration.

On castration.

The scrotum having been shaven, and the skin over the testicle made tense, a free incision is to be made through the scrotum and tunica vaginalis down to the tunica vaginalis testis, and the body of the organ with the cord exposed. When any doubt as to diagnosis exists, an incision should be made into the growth before its removal. A strong double carbolised silk or catgut ligature should then be passed between the structures of the cord and firmly tied in halves; the cord should be divided below the ligatures, and the tumour turned out of its scrotal covering. There is no necessity to take away any of scrotum however stretched, unless diseased, since it is sure to contract. All vessels should be twisted, the wound washed out with some hot iodine water and dried, and a few sutures put in at the upper part of the wound; a drainage tube should be introduced at the lower part of the wound, and the patient put to bed with the purse raised by a small pillow. No pain is caused when the ligature of the cord has been tightly tied. Recovery is as a rule rapid after this operation.

To take the vessels of the cord up singly is a troublesome operation and has no advantages. No assistant can hold the cord with his fingers after its division, as it is sure to slip from his grasp.

Fig. 383.



Strapping testicle.

On strapping a testicle.

To strap a Testicle requires some skill. The patient should be made to stand against the edge of a table and separate his legs. The Surgeon should then with his left hand grasp the organ from behind and press it down to the bottom of the scrotal sac, making the scrotum tense over its surface, the thumb and index-finger of his left hand holding its neck. A piece of strapping spread on leather, half an inch or more wide, is next to be wound round the neck of the tumour once, twice, or even thrice to hold it in position, for if this point be not attended to, all the subsequent steps will be useless. (Fig. 383.) Having done this, pieces of strapping three quarters of an inch long are to be applied vertically from one side of the circular strip to the other, sufficient force being employed to compress the organ. When the testis is completely covered in and compressed, another circular piece or so should be applied to keep the whole in position, and to bind down the ends of the vertical pieces. The strapping will probably require re-application every second day as the parts soon yield, and the strapping then forms a loose bag. The student must remember that the object of the strapping is to compress the organ, and not to cover it.

For the purpose of compression a narrow rubber bandage may be employed with advantage.

Malposition of testis.

Imperfect transition and malposition of the testicle is occasionally met with, the organ being either arrested in some part of its course into its scrotal pouch, or, misplaced. At times one testicle is found in

Arrest of descent.

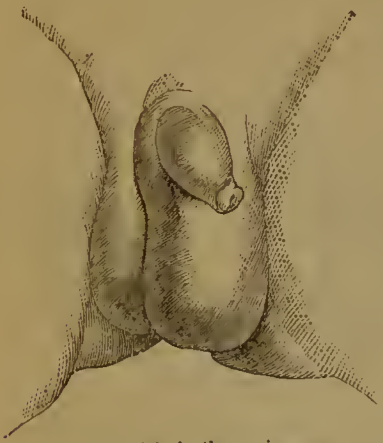
Treatment.

the canal, or it has failed to put in an appearance at all; while at others both are found to be out of place. Not uncommonly, this arrested descent of the testicle is complicated with a congenital hernia, the vaginal process of peritoneum being still open, and in all cases of scrotal swelling in infants, the Surgeon should examine the parts with care to discover whether the testicle is or is not involved in the tumour. When the testes are thus placed, they are very commonly ill developed. At times during their descent through the rings, they are nipped by the muscular structures, and become inflamed. I have recorded such instances in a former page. Nothing can be done by way of treatment to expedite the descent of the organ. When within the internal ring and complicated with hernia, it is well to recommend a truss; but when the testis is in the canal, such an instrument cannot be worn, an extra element of danger, under these circumstances, being added to the case.

May be the seat of disease.

Testes so situated seem to be very prone to become the seat of cancerous disease. Many such cases have been recorded.

FIG. 384.



Right testicle in the perinæum.

In a case under my care, of a gentleman over fifty, an encysted hydrocele was found with a small testicle situated in the centre of a congenital hernia, the cyst on the reduction of the hernia appearing as a tumour the size of a small orange, below the external ring and behind the hernia. I tapped it from behind, and drew off about two ounces of a milky fluid containing many spermatozoa, and injected it with iodine. A good result followed. This gentleman was married, and had a family.

Malplaced testes.

Malplaced testicles are less common than those just described. I have, however, seen at least ten cases; in five, one of which I have reported ('Guy's Hosp. Reports,' 1867), the right testicle was placed in the perinæum in its own separate scrotal pouch (Fig. 384), whilst in the other five the right testicle was in the perinæum, but outside the scrotal sac, which was otherwise natural. There was in one a hernia associated with the malplaced testicle; the bowel clearly descending into the tunica vaginalis down to the testicle. It would seem that the right testis is more prone to malposition than the left.

Varicocele.

On varicocele.

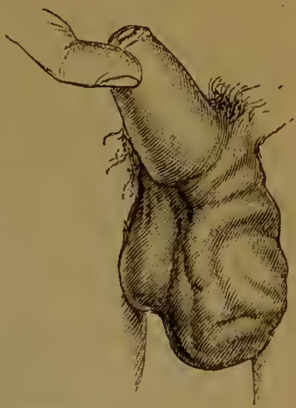
Causes.

This signifies a varicose condition of the spermatic veins, and when the disease is well marked their tortuosity and dilatations present the appearance (Fig. 385), and impart the feeling of a "bag of worms" within the scrotum. It is more common on the left than the right side, the assigned causes of this preponderance being the more dependent position of the left organ, and the liability of the vein to be pressed upon by a loaded sigmoid flexure of the colon. It is a disease of young adult life, and is the cause of the rejection in the British army of about

15 recruits in the 1000. It is doubtless often, although not always, the product of masturbation, or excess of venery, but anything that retards the return of the venous blood from the organ aggravates, if it does not really cause it. The affection is generally accompanied by a dull aching pain in the part, as well as a sensation of weight or fulness, but these symptoms are rarely complained of at an early period of the affection. The pain often passes up the groin, even to the loins, and is relieved if the patient assume the recumbent position, or even by elevating the scrotum.

Symptoms.

FIG. 385.



Varicocele taken from case of Mr. Jacobson's.

Treatment.

TREATMENT.—If constipation exists, the bowels must be regulated. If the scrotum be pendulous, cold bathing ought to be recommended, and the organ supported by some suspensory bandage. Tonics are often of use. When this palliative treatment gives relief, and retards the progress of the disease, nothing more is needed; but when the disease is severe, and these means are ineffectual, a more radical treatment is called for, which consists in the excision, destruction, or division of the veins.

Subcutaneous operation.

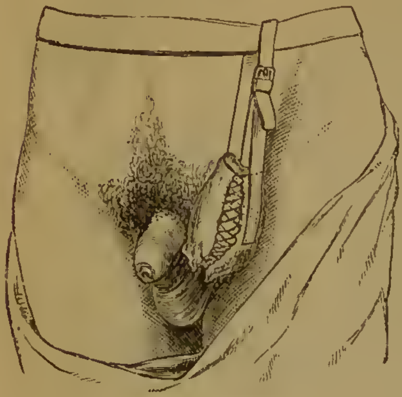
Excision is a practice which has been reintroduced since antiseptic surgery has become a fashion, and consists of the removal of about an inch of the diseased vein below the external inguinal ring, after the application of a ligature of carbolised catgut above and below the part to be removed. Good results, as a rule, follow this practice, but I have known of bad, and regard the operation as more dangerous than that now to be described.

Operation of ligature.—This is a subcutaneous operation, and is most successful. Some Surgeons employ metallic wire for the purpose, others carbolised silk, catgut, or kangaroo-tendon ligatures. Mr. Lee uses two pins to arrest the flow of blood through the veins, and performs subcutaneous division of the vessels between them; I prefer, however, the ligature. Sir B. Brodie used to divide the veins subcutaneously, and apply pressure. Mr. J. Wood, of King's, subcutaneously surrounds the veins with a double wire noose, and keeps up pressure upon the wire by means of a metallic spring till the division of the veins occurs. The operation I prefer is performed as follows:—Under an anæsthetic or not, the scrotum on the side of the varicocele is to be taken between the fingers and thumb, and the vas deferens (which may always be known by its cordy hardness) allowed to escape; so soon as this is done, a needle armed with the ligature should be passed through the scrotum *beneath* the bundle of spermatic veins, and drawn through. A Liston's needle, on a handle, should then be introduced through the same skin opening as was made by the first needle, and passed in *front* of the veins, and its point brought out at the point of exit of the first needle. The ligature first passed is then to be threaded through the eye of the needle, which should be drawn back. When this step has been done, the bundle of veins have been surrounded, and may be occluded by firmly tying the ends of the ligature. It is a good plan, before tying the ligature, to divide the skin at its point of exit and entrance with a tenotomy knife, the loop of the ligature by this step being lost in the tissues and made subcutaneous. A second ligature is to be applied in like manner, half an inch or more lower down or higher up, as the case may be; and after this the veins may or may not be divided subcutaneously between the two needles by a tenotomy knife. Of late years I have left this part of the operation out, with no detriment. As a general rule, this operation is most successful, and not dangerous. It is only to be done, however, when palliative treatment fails.

Morgan's suspender.

Mr. Morgan, of Dublin, has recently suggested an admirable suspender for varicocele and other affections of the testis, which is illustrated in Fig. 386. It consists of a piece of webbing 4½ inches long, 3½ inches wide at one end, 4 inches at the other, and gradually tapering to the narrower end. A piece of thick lead wire is stitched in the rim of the smaller end, two tapes sewn along the entire length of the webbing, and the sides furnished with neat hooks, a lace, and a good tongue of chamois leather. When the suspender has been applied to the testicle the tapes are to be attached to an abdominal belt. The size may vary more or less. The lead wire encircling the lower end gives a foundation to the general means of support, and keeps the testis within the bag; the patient can mould it more or less to his convenience, and it need not be worn at night.

FIG. 386.



Morgan's suspender.

Fatty tumours.

Fatty tumours are occasionally met with in the cord. I have removed one the size of a walnut; and fibrous or sarcomatous tumours have been met with on the testicle. I have seen one of the latter the size of an orange, excised by Mr. Hilton, from the testicle with success.

Affections of the Scrotum.

Affections of scrotum.

Effusion of blood.

The scrotal pouch is very frequently the seat of injury, while the testicle, from its mobility escapes. When the parts are bruised, the effusion of blood is at times very great, the blood forming a large diffused scrotal hæmatocele, while at others, it forms a distinct tumour. On January 29th, 1871, I was consulted by T. B—, æt. 40, who sat down on the broken arm of a chair, the stump of the arm bruising the perineal border of the scrotum. A swelling at once appeared, and when I saw him, twenty-six hours after the accident, a well-defined blood tumour existed in the median line of the scrotum, the size of a cocoa-nut, the two testicles maintaining their position on either side. By rest, cold lotion, and tonics, the blood was absorbed in three months.

Wounds.

Lacerated wounds of the scrotum are also attended with blood extravasation, but they usually heal readily on account of the vascularity of the parts.

Œdema of scrotum.

Œdema of the Scrotum takes place when inflammation attacks neighbouring structures. It is seen in the inflammation of the epididymis associated with gonorrhœa and in acute orchitis; in extravasation of urine and urinary perineal abscess; in the retention of urine in childhood due to the obstruction of a calculus; in phimosis or paraphimosis; in erysipelas. In all these cases it is present with more or less redness and external signs of inflammation.

Simple œdema is one of the first indications of renal or cardiac dropsy.

Elephantiasis of scrotum.

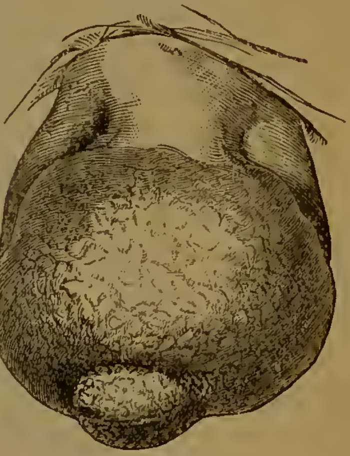
Elephantiasis of Scrotum.—The scrotum is, not rarely, the seat of *elephantiasis arabum*—solid œdema of the scrotum, and the disease generally attacks the penis as well. In tropical countries where this affection is common, the tumours attain an enormous size. It is the same disease which attacks the female genitals and other parts of the body and extremities; and in the West Indies is known as the "Barbadoes leg." By Mr. Dalton of Guiana, and other observers it is regarded as a constitutional disease.

Examples.

Fayrer's mode of operation.

For its true pathology refer to p. 235, vol. i. It is occasionally associated with ichthyosis of the tongue, and is often attended with fever and local erythema with œdema, which never subsides. When attacking the scrotum nothing but its excision is of any use. The historical case in which Mr. Key removed from a Chinaman, æt. 32, a tumour weighing fifty-six pounds (Prep. 1620^{69}, Guy's Museum), of ten years' growth (Fig. 387), is a good case in point, but the growths attain a larger size than this. Mr. Wiblin, in 1862, excised a growth equally large, and in the 'Med. Chir. Trans.' for 1863 the report of his case will be found, with a reference to others. Such growths are made up of the elements of ordinary connective tissue. Sir J. Fayrer, who has operated on many cases, writes:—"The operation for removal of a scrotal tumour is simple enough, but it requires determination and expedition. It needs also the aid of intelligent assistants. Before commencing it is well to have the tumour raised and supported in a vertical position for half an hour, to drain it of blood as much as possible; then the patient having been placed in a recumbent position on an ordinary table, with the nates brought near the end of it, he is to be put under the influence of an anæsthetic, and the incisions are to be commenced. Several assistants are required to hold back the legs, raise the penis and testes, support the tumour, and rapidly secure the bleeding points. These being provided, the operation may be begun. The director is to be introduced into the passage at the bottom of which lies the glans penis, and that organ exposed by laying open with either the long catlin or sharp-pointed bistoury the dense tissue covering

Fig. 387.



Elephantiasis of the scrotum. (Key's case.)

it. If the prepuce is healthy, it is well to reflect a portion of it as a future covering to the penis. If the prepuce is involved, or even suspected of being involved, it should be carefully dissected away like the rest of the thickened tissue. Having exposed the penis, it is to be raised and carefully dissected out, with or without the prepuce, as the case may be. This is to be raised and held aside by an assistant, care being taken in clearing it out of the morbid tissue not to divide the suspensory ligament.

Second step of operation.

"The next step is to make a deep and bold incision down to the tunica vaginalis on one side. In a large tumour several incisions will be needed before the tunica vaginalis is exposed, which probably will be found much thickened and distended with fluid, forming large hydroceles. These should be laid open, and if the tunica vaginalis be much thickened it should be removed; if not so affected, and the testicle not enlarged, it need not be interfered with. The testicle is then to be dissected out, reflected, and held upwards with the penis. A similar proceeding is to be carried out on the opposite side. The tumour is then to be removed by connecting transversely the three vertical incisions already made, and then, either with the scalpel or amputating knife, the remaining portion of the neck of the tumour is to be cut through. It is well before separating it to mark out on the perineal aspect by an incision the line at which the removal is to be completed. During the operation, vessels are to be commanded by the fingers of assistants, and large veins controlled by forceps. It is well that even the most minute bleeding point should be ligatured (or twisted), otherwise when reaction occurs there may be hæmorrhage. The bleeding having been controlled, the testes with their elongated cords are to be applied to the surface of the wound; the penis is to be enveloped in a fold of oiled lint, and thus kept apart from the testes, which are also covered and supported in position by oiled cloths." The largest tumour of this kind on record weighed 200 lbs.

Dr. Turner of Samoa ('Glasgow Med. Journ.,' Jan., 1883) uses a clamp with a notch in its centre for the urethra, to compress the base of the scrotum after it has been drained of its blood by elevation. He likewise lays great stress upon the propriety of dissecting out the penis and testicles before any attempt is made to remove the tumour. Other Surgeons have used a rubber tube to compress the base of the tumour.

Cancer of the Scrotum.

Cancer of scrotum.

This is a rare affection compared with what it was some years ago when sweeps ascended flues. It is still, however, met with in this country as a *chimney sweep's cancer*. On the Continent it is well known in the tar and paraffine manufactories. The products of distillation of coal, according to Volkmann, being more irritating to the human skin than soot. The disease is in reality an epithelial cancer similar to that found in other parts of the body; at times it is very extensive, and involves the whole scrotum. Nothing but its removal can be recommended. Small tumours may be cauterised down or destroyed by caustics, but the larger should be excised. When the growth can be isolated by pins passed through its base, the platinum wire écraseur heated by the galvanic battery is probably the best instrument to use, otherwise the knife is to be employed. When the whole scrotum is removed and the testes are left exposed, hanging from their external

Treatment of cancer scroti.

Lee's operation described.

rings, the Surgeon need be under no alarm, for the parts will granulate up in the course of time, and, what is more, the testicles may become movable. I have seen this take place more than once. The earlier the disease is removed the better, for by delay the glands of the groin may become involved.

Other diseases of scrotum.

The scrotum is occasionally though rarely the seat of tumours, sebaceous, fatty, fibrous or sarcomatous. It is, likewise, the seat of varicose veins; the small venous radicles appearing as beaded dilatations of a peculiar aspect; the disease is, however, of little importance.

Tumours or swellings that encroach upon the scrotum from the perinæum are probably inflammatory, and are most frequently urinary abscesses associated with and dependent upon some stricture; but occasionally an anal abscess may press forward, and I have seen one occupying the whole perinæum up to the scrotum. These are to be treated by free incisions.

STERILITY.—MALE IMPOTENCE AND SPERMATORRHŒA.

On impotency.

The influence of the sexual functions is so great in the economy of human life, that any impairment of the organs concerned is a matter of importance, not only in its effects on the bodily health, but even more on the mental state of the person affected.

The sexual act is a compound one, physical and mental. The physical organs may be perfect and capable in their way, but if the mental are deficient in energy or weakened by doubt of competency, or under the influence of some emotion such as shame or fear, the sexual act will be spoilt, and failure to complete it must ensue.

Causes.

It is, therefore, clear that impotence, real or imaginary, may be due to either physical or mental causes.

Irremediable.

Remediable causes.

Taylor defines *impotency* "to be an incapacity for sexual intercourse." This incapacity may ensue from physical causes, remediable or irremediable. The latter includes loss of penis and testicles, deformity of penis, including excess of and arrest of development, maldevelopment, in such cases as ectopia vesicæ, &c. The remediable causes may be some local affection of the penis or testes.

Any condition that prevents the introduction of the organ into the female passage is enough to cause impotence, whether such condition be connected with the penis or testes. The same effect is produced by any disease or congenital malposition or development of the testes, attended with loss of sexual desire, as by old age. A man may, therefore, be impotent and virile, or impotent and sterile.

Conditions in hypospadias.

A man may be capable of sexual intercourse and yet be sterile; sterility in the male depending much upon the secretion of the testes, as well as upon the formation of the penis, for semen without spermatozoa is destitute of procreative power. A man may have a penis the subject of epispadias or hypospadias; he may have sexual desire, and even power, but if the urethral orifice be so low down as to prevent the semen from being conveyed into the vagina, he will be sterile; though all patients with hypospadias are not so. I have known two men who had hypospadias—the orifice of the urethra in each, opening one inch behind the normal urethral opening—to be the fathers of three and four children respectively; and a third, in whom the urethral orifice was one inch behind the glans, whose wife died in childbirth.

When the urethral orifice is at the base of the penis, sterility must, however, exist. When partial epispadias exists, there is no reason to believe that a man must be sterile.

Crypsorchides.

Conditions in misplaced testes.

When both testes are misplaced—that is, when they have not descended into the scrotum—there is a strong probability that the organs are badly developed, that they do not secrete healthy spermatic fluid, and that sterility is the result. Curling asserts this very positively to be the fact, but he at the same time brings forward evidence from Messrs. Cock's and Poland's practice that such is not always the case. In a general way Mr. Curling may be right, but there are many exceptions to such a rule. When one testis is in the scrotum and healthy, there is no reason to suspect sterility.

Monorchides.

Sterility following disease of testes.

Varied sources of sterility.

Sterility sometimes follows disease of the testes, inflammatory or otherwise; for epididymitis or inflammation of the duct of the testicle, as well as testitis or inflammation of the gland may be followed by atrophy of the organ. Gosselin, Godart, and Liegeois have laid great stress upon this; and Curling ascribes these as common causes of sterility. Sterility may also be produced by involuntary seminal emissions the result of excess of venery or masturbation, by producing either loss of sexual power or deterioration of semen. Stricture, or any impediment to the seminal discharge, is also another cause. The student must remember, too, that a man may be capable of sexual intercourse and be sterile from other causes. He may even have emissions in connection without seminal secretion, for the emissions may consist only of secretion from the seminal vesicles. I have known this fact illustrated in a man who had lost both his testicles from a surgical operation, and yet had sexual power as strong as ever, attended with emission. The removal of one testicle seems to interfere but little if at all with sexual power. Some years ago I removed a testicle for cystic disease from a gentleman who had been married many years and had no child. After the operation his wife soon conceived and gave birth to a boy.

Impotence in the female.

In the *female* subject, impotency may be said to exist when the vagina is absent or obliterated. It is for a time present when the orifice is occluded by some dense membrane, or when the introduction of the male organ is prevented on account of the smallness of the orifice, by vaginismus, or the presence of a bifid vagina.

Sterility is due to many causes, the occlusion of the os uteri being one, but morbid conditions of the uterus and ovaries are probably the more frequent.

Testes do not waste for want of use.

The student should remember that "the functions of the testicle, like those of the mammary gland and uterus, may be suspended for a long period, possibly for life; and yet its structure may be sound and capable of being roused into activity" on any healthy stimulus. Unlike other glands, it does not waste or atrophy for want of use, the physical parts of man's nature being accurately adapted to the necessities of his position, and to his moral being.

Spermatorrhœa.

On spermatorrhœa.

Attendant symptoms.

Causes.

Effects.

This doubtless exists as a disease although rare. It consists in the discharge of spermatic fluid containing spermatozoa with the urine, without sexual desire or sexual excitement. It is commonly associated with some derangement of the digestive organs, constipation, and rectal irritation, spasmodic action of the levator ani acting on the vesiculæ seminales and prostate gland. In its most complete form it is associated with an absolute loss of sensation about the veru montanum on the passage of a sound, a patient thus affected allowing the introduction of an instrument without flinching; whilst the worst cases are associated with wasting of the testicles and varicocele. It is at times without doubt due to excess of venery, but more commonly to masturbation. It commences almost always with nocturnal emissions, which gradually become more frequent. These are at first attended with erotic sensation, although not so subsequently, and at last occur without erection. If copulation be attempted the ejaculation takes place at once, often before the introduction of the organ. It ends in the total loss of sexual inclination and power. Lallemand says that "seminal emissions supervening during micturition are the most serious."

Lallemand's views.

He holds that "spermatorrhœa is nearly always dependent upon irritation of the prostate gland and its ejaculatory ducts, and believes that in most cases this irritation, which also exists in the neck of the bladder, is the result of chronic inflammation of the urethra in the prostatic portion of the veru montanum. An old attack of urethritis is the most frequent cause of the seminal emissions, and these emissions are often related to stricture of the urethra."

Trousseau's views.

Trousseau, however, while admitting the force of these observations, believes that spermatorrhœa or incontinence of semen is due to some imperfection in the nervous system of organic life, since it is so commonly found in men who have had incontinence of urine in childhood. He looks upon the masturbation as an indirect proof that there is a bad state of the nervous system, and the subsequent impotence, insanity, or paralysis, as an aggravation of a nervous condition, of which masturbation was only the first morbid manifestation (Trousseau, 'Clin. Med., vol. iii). This latter view is supported by the fact that in some cases of injury to or disease of the spinal column, spermatorrhœa is a common associate.

False spermatorrhœa.

False spermatorrhœa is, however, a more common complaint. It is supposed to be present when nocturnal emissions are frequent, when diurnal emissions take place on any sexual thought, and urethral discharge of a glairy fluid attends defæcation, when erections with discharge follow the slightest irritation, such as that produced by riding or walking, from the friction of trousers, &c. Such cases are far from rare; and are commonly due to masturbation, but are not cases of true spermatorrhœa, although they often precede it. Nocturnal emissions may be too frequent, but, if associated with sexual feeling, they are natural. They should, however, be checked, as they lead on to the true disease. The glairy fluid pressed out in defæcation is rarely seminal; but is prostatic, of a transparent, tenacious character, and not milky. The whole genital tract in this affection is in a state of morbid sensibility, of hyperæsthesia, and requires treatment since the false spermatorrhœa is often only the prelude to the true.

Treatment. Belladonna. Tonics. Local blistering

TREATMENT.—Trousseau, regarding masturbation as a manifestation of some disease of the nervous centres, speaks strongly in favour of belladonna, and, so far as my experience has gone, I am disposed to think it a valuable drug given in half-grain doses of the extract twice a day, with some tonic, such as iron, zinc, strychnine, or quinine. It seems to act most beneficially, and to check the disposition to masturbate in a marked manner. Of course, this good can only be met with when there is in the patient's mind a strong wish to overcome a repugnant habit. To aid this the application of a ring of blistering fluid around the penis, or painting the prepuce with iodine, is a valuable adjunct. The bowels, more particularly the rectum, under all circumstances, should be kept empty, and the nightly injection of cold water into the bowel is a useful custom. The patient should sleep upon a hard bed, and be lightly covered. He should not rest on his back, and a solid substance fastened in a handkerchief over the sacrum is a good mode of securing this end.

Caustic solutions to orifice of ducts.

When evidence exists that the mucous membrane of the prostatic urethra is affected near the orifices of the spermatic ducts, Lallemand's advice of applying a solution of nitrate of silver (gr. v to gr. x to the ounce) every other day should be followed. Some Surgeons use a stronger solution, and when an absolute loss of sensibility of these parts is present, galvanism has been highly spoken of. For the application of the solution, Erichsen's syringe catheter is the best. Every means should be employed to divert the patient's mind from the seat of his affection by encouraging mental as well as physical labour. Simple nutritious food should be allowed, and cold bathing adopted.

Imaginary impotence.

In the cases of imaginary impotence of young married men, all that the Surgeon has to do is to give confidence, for the failure is probably in the mind rather than in the body of his patient. The best advice is, to recommend abstention from coitus, when Nature in her own time will have her way, and assert her power.

CHAPTER XXV.

SURGICAL AFFECTIONS OF FEMALE GENITALS.

Wounds of female genitals.

Wounds of the external genitals are met with in practice as the result of violence intentionally committed, or happening accidentally from falling or sitting on pointed or cutting bodies. They are always serious on account of the bleeding that attends them, and wounds of the vagina are particularly so. However severe they are, they should be carefully cleansed, adjusted, and stitched together, for these tissues are very vascular and heal well.

Laceration of vagina.

Severe lacerations at times take place in the attempt at coitus. Some years ago, I was called to a young married woman for severe hæmorrhage from these parts following marital intercourse the night after marriage, and found two severe lacerations of the orifice of the vagina and the hymen unruptured; the membrane had been practically driven in. Pressure arrested the bleeding.

Wounds of the vagina are apt to be followed by inconvenient cicatrices.

Foreign bodies in vagina.

Foreign bodies are also at times introduced into the vagina for criminal or erotic purposes. Mr. Hilton removed at Guy's a flat bone-netting mesh, ten inches long, which had passed through the vaginal walls into the pelvis. Bottles and other foreign matters have also been introduced. Sponges are not uncommonly found in the passage, and in a case I knew of, such a foreign body gave rise to the suspicions of cancerous disease.

Adherent Labia.

Adherent labia.

The labia during childhood are apt to adhere together from some local inflammatory action, and so to close the labial orifice as to interfere with the act of micturition. The urine in children thus affected, often squirts in a backward or forward direction, and for this, surgical attention is sought. In these cases, the true condition of affairs will at once be recognised on separating the genitals, for the labia will be found connected together by a membranous adhesion which passes forwards in some cases to the urethral orifice, thereby affecting the urinary stream. This membrane is readily broken down by separating the labia with the fingers or thumbs, or by means of a probe introduced behind it from above. The application of a little cold cream will complete the cure if care be taken to keep the parts clean.

Vulvitis.

Vulvitis.

This is a common complaint in children, and is almost always due to some rectal irritation such as that caused by worms, scybala, &c., in the feeble and badly fed. It is rarely the result of a gonorrhœal affection, as is too often suspected, and it is well to be aware of this fact, as it is not uncommon for a Surgeon to be consulted about a child with vulvitis under the suspicion that the affection is the result of an impure criminal contact, when it is due to some simple non-venereal cause.

Treatment.

It should be treated by local cleanliness and mild astringent lotions, such as lead, alum, &c.; when worms are suspected, by the administration of a good mercurial or jalap purge, and attention to the digestive organs and general health; a mixture of rhubarb and soda for a few days, and subsequently a tonic, generally effect a cure.

Phagedæna of labia

Noma, or phagedænic ulceration of the labia, similar to the cancrum oris after the exanthemata, is met with in cachectic children, and is a disease of debility. It commences as an inflammatory swelling of the parts similar to erysipelas, passing on to gangrene and ulceration, and is always attended with great prostration. For its treatment such tonics as can be borne should be given; and particularly iron, quinine, or bark. Wine and abundance of good liquid nourishment should be given by the mouth, or, by the rectum when the stomach rejects it, and milk with chlorate of potash is a good drink. Locally, opium lotion with carbolic acid, nitric acid, or nitrate of silver should be used, and when the ulceration spreads, nitric acid in its concentrated form may be applied or the actual or galvanic cautery.

Treatment.

Nævi, when found involving these parts, are to be treated like others.

Labial hernia. Varicocele.

Hernia.—In women, the labium may be the seat of an inguinal *hernia* or of a *varicocele*. The former is known by its own symptoms, the

Thrombus.

latter by its wormy feel. It may also become the seat of *thrombus* or blood tumour on the receipt of an injury, which is to be made out by the history of the case, the sudden appearance of the swelling after an injury, its external aspect and fluctuating feel. Such blood swellings are to be treated at first by the local application of cold to arrest the flow of blood, and, subsequently, by lead lotions. If they tend to break up and form an abscess, a free incision into the swelling is the right treatment to adopt.

Abscess.

Labial Abscesses form at times as a result of a softened thrombus but more frequently from follicular inflammation. They are very painful and ought to be opened early. Occasionally, they are the consequence of an inflamed cyst.

Cysts in labium.

Labial Cysts are very common, and are usually met with on the inner side of the labia. They are similar in their nature to the mucous cysts found in the mouth or about the tongue, and are formed in the same way by the obstruction of the ducts of the mucous glands of the parts. They appear as chronic painless swellings, producing only mechanical inconvenience; but if neglected they may inflame and suppurate. On manipulation, they feel tense, globular, and semifluctuating, and contain a glairy brown or blood-stained fluid, at times with cholesterine. They are to be treated by excision, or the removal of the presenting surface of the cyst by a pair of forceps and scissors, the removal of one wall exposing the other, which contracts. Excision, however, is the safest practice. When an opening into the cyst is made, the cavity should be plugged with lint, or with lint soaked in tincture of iodine—this fluid exciting adhesive action or suppuration in the cyst wall. When the cyst suppurates it is to be laid freely open and dealt with as an abscess.

Treatment.

Mucous cysts, like these, are also found in the vagina.

Sebaceous tumours.

Hypertrophy of labium.

The internal labia may also be the seat of *sebaceous tumours*, and of a solid œdema or hypertrophy similar to that seen in the male scrotum not unlike *elephantiasis*, and grow to a large size. Nothing but their removal can be entertained. Some time since, I removed with the galvanic écraseur from a middle-aged woman, both labia which had attained the size of a cocoa-nut without the loss of a drop of blood, after having isolated the growths by long pins inserted through their bases, and passed the wire round the pins. When this instrument cannot be obtained, the knife must be employed. Such tumours are highly vascular, and the Surgeon requires good assistants in their removal.

Cancer of labium.

Cancerous tumours, both epithelial and otherwise, of these parts are also met with, and are known by their ordinary features; they should be treated by removal. It seems that cancer is prone to appear in these regions at an earlier period of life than in others. In 1869 I removed a well-marked cancerous tumour from the labium of a woman only thirty-two years of age.

Epithelium of clitoris.

Galvanic cautery.

Epithelial disease of the clitoris occurs at times, and I have seen several well-marked cases, but more commonly it attacks the inner labia and orifice of the vagina. In such cases the benefit of the galvanic cautery is well illustrated, for the removal of these growths by excision is very difficult, and always attended with copious bleeding. When the whole growth cannot be isolated, as much as possible should be excised or scraped off, and the cautery freely applied to the surface and base of what remains. Where the growth can be isolated by the introduction of long pins beneath its base and a wire adjusted beneath the pins the galvanic écraseur, not made too hot, and slowly worked, is an admirable instrument to employ. By its means I have successfully removed on several occasions without the loss of a drop of blood an epithelial cancer occupying the fourchette of the vagina, encroaching on the passage and the perinæum. The patients were under chloroform during the operation and felt no pain; the after-pain in these cases being always slight, the cautery entirely destroying the sensibility of the divided parts. Wounds so made heal kindly.

Galvanic écraseur.

Lupus also attacks these parts like others; while *warty growths* are common.

Syphilis has received attention in another page.

Imperforate Hymen is a condition to be recognised and not confused with the adherent labia already referred to. The hymen is more deeply placed nearer the orifice of the vagina. When imperforate, it causes retention of the menses, the accumulation of the secretions, and a pelvic tumour usually accompanied by periodic pain and constitutional disturbance.

Imperforate hymen.

The proper treatment of these cases is the division of the imperforate membrane or its complete excision, the object being to allow of the free escape of the retained secretion which is usually black and treacle-like. Success usually attends this practice, though a fatal peritonitis at times ensues.

Treatment.

A Rigid Hymen is occasionally an impediment to coitus in women who marry late in life, and I have known one in which for two years after marriage the husband had never had perfect connection on this account; indeed, it was not till after his wife had become pregnant and the vaginal membrane had been ruptured during the birth of the child, that a satisfactory coitus was effected.

Rigid hymen.

I have also been called upon on one occasion, to divide the hymen of a lady about thirty, who had been married for some months and had never had complete connection, the husband's penis having been very large.

May require division.

There are cases on record, showing that when a vagina is occluded and the patient been married, the urethra has been so enlarged as to admit the finger, and in all probability the male organ.

A Double Vagina is another cause of difficult coitus. I was consulted in such a case by a patient who had been married for several years, and never had connection. The woman came to me as a divorce was under consideration. She complained of extreme pain whenever an attempt at coitus was made, and the husband of inability to penetrate. On making a careful examination, a double vagina and uterus were discovered. I advised the division of the septum with the galvanic wire, by perforating the septum near the uterus and gradually dividing it by means of steady traction upon the wire; but whilst the question was under the consideration of both parties, the suspicion of pregnancy occurred, and time proved its truth. A child was born prematurely after a tedious labour, and I heard no more of the difficulties of the case. She became pregnant a second time.

Double vagina.

Example.

Besides these deformities, others may occur, such as occlusion of the vagina or absence of the uterus, or the opening of the rectum into the vagina, &c.

The *clitoris* is occasionally enlarged at birth, appearing as a small

Enlarged clitoris.

penis. I have seen an example of this, and at the end of the clitoris a depression existed corresponding to the male urethra. The child in other respects was natural. This organ, however, may in after life, become the subject of hypertrophy, indeed, of a kind of elephas as of the male penis, and require removal.

Clitoridectomy condemued.

Clitoridectomy for epithelial cancer has already been alluded to. This operation has been practised for epilepsy and supposed erotic complaints, but evidence is wanting to justify the step. The operation for such purposes appears at present to be unjustifiable.

Vaginal tumours.

Vaginal Tumours, besides the cystic and epithelial, are occasionally met with, and vaginal polypi are found. I removed one the size of a nut from a child three years old, and similar cases are on record. They should always be ligatured and excised.

Rupture of the Perinæum.

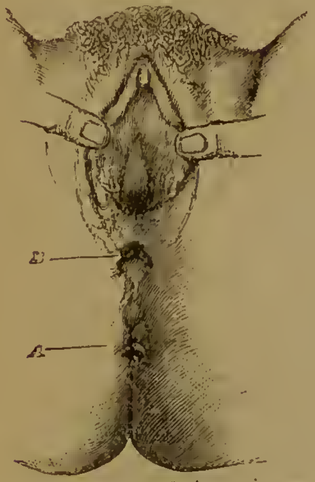
Rupture of perinæum in the female.

This accident is not rare as a result of a rapid delivery, and to a small extent it is somewhat common in first labours.

Consequence.

When limited, it is not of much importance; but when extensive, the pelvic organs lose their natural support and are liable to fall, giving rise to *rectocele* or prolapse of the posterior wall of the vagina, or *cystocele* or prolapse of the anterior wall of the vagina.

Fig. 388.



Central rupture of the perinæum through which child was born.

When the sphincter ani or rectum, is implicated, the accident becomes of grave importance.

At times the rupture is central, and in the case from which Fig. 388 was taken, the child was born through the rupture B. The incident took place in the practice of a medical friend who sent the case to me. Dr. Wilson witnessed a like process in a similar case ('Ed. Med. Journ.,' April, 1875).

There is no reason to believe that rupture of the perinæum is in all cases the fault of the accoucheur, although, doubtless, it is so in some; yet with a large child and rapid labour, it is often difficult to prevent. I have known it occur in the practice of very good men.

Treatment.

Immediate operation advised.

Slight ruptures of the perinæum need not be regarded, but when a rupture into the body of the perinæum takes place during labour and the accident is recognised, the best practice is to put in one or more sutures at once. This practice is so sound that it cannot be too confidently recommended.

Period for operation remote.

When the operation is not performed at once but postponed to the future, it must be left till the period of suckling has passed and the general health of the patient been restored; the operation being a plastic one, requires good power on the part of the patient, and immediate union of the wound is wanted for success. It is very successful when properly performed; indeed, it rarely fails.

Operation.—The bowels should be well cleared out by an aperient

Description of the operation.

given two days before, and an enema on the day of operation. An anæsthetic should be given, the patient placed in the position for lithotomy, with the buttocks brought to the edge of the table, and Clover's crutch applied to keep the knees apart. The vagina should be well washed out with a carbolic acid or iodine lotion. An assistant should then well separate the labia while the Surgeon with his scalpel maps out the portion of the integument that he proposes to raise (A, C, D, B, Fig. 389), remembering that it is necessary to have a broad surface to bring together as well as a cleanly cut one, since a thin membranous union is useless, and a jagged surface will not unite.

At least an inch of raw surface should be provided on either side of the perinæum for union, the width of the bared surface diminishing slightly towards the anterior portion of the labia, and widening towards the anal end. *No tissue is to be sacrificed.*

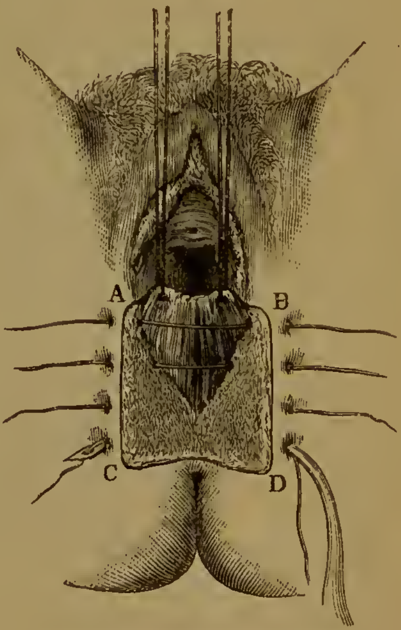
The incisions should be carried along the outer border of the cicatricial tissue, and extend from A to C and from B to D, with a transverse cut from C to D; and this broad flap is to be raised towards the vagina, and held up by an assistant, two sutures inserted into the angles of the flap helping this act (Fig. 389).

If bleeding follows, the larger arteries may be twisted while a little pressure soon controls the smaller.

Introduction of the sutures.

The *second* step of the operation, or the introduction of the sutures, remains to be performed, and it is of no less importance than the first. Four or five sutures are required, and they should be of silkworm gut; they should be introduced from a quarter to half an inch from the margin of the wound, the one nearest the rectum being first inserted. The introduction of the first suture is of primary importance. It should be passed deeply through the left side of the wound rather behind the level of the recto-vaginal septum, through the tissues and the septum, and out at a corresponding point on the right side; it should be completely buried in its whole course, with the object of drawing the recto-vaginal septum well forward (*vide* Fig. 389). A second, third, and fourth may then be introduced, as indicated in the drawing.

FIG 389.



Operation for ruptured perinæum.

A, C, B, D, represents the surface from which the flap is raised, with the sutures introduced prior to the approximation of the two sides.

A needle, such as that seen in Fig. 389, is the one I employ. It is curved on the flat, so as not to cut the recto-vaginal septum in its passage, and has an eye in its point to admit the suture. The parts should be brought together carefully, and pressed together firmly after their apposition; several superficial sutures of fine carbolised gut may be introduced should they be required. If there be much spasm of the sphincter the muscle may be well stretched.

After-treatment

After the operation is completed, the Surgeon should satisfy himself that the parts are in apposition, and the vagina should be well syringed. Some iodoform gauze should be applied to the wound with some iodoform powder, and a morphia suppository placed in the rectum to relieve pain and spasm.

The patient ought then to be removed to bed, and her legs tied together, and flexed upon the abdomen. The urine should be drawn off every six hours for the first three or four days, and the parts kept clean. Iced milk and beef tea should be given for the first day, but meat and wine subsequently if the appetite allow. The patient may lie on her side should she wish. The sutures need not be removed till the fifth or sixth day; but after the fourth day they should be taken away if suppuration appears in their track.

Removal of sutures.

On withdrawing the sutures great care should be observed not to separate the thighs or parts; indeed, for quite ten days or more after the operation this point should be observed.

When catheter to be dispensed with.

After the first week the use of the catheter may be dispensed with, the patient making water on her hands and knees, the parts subsequently being carefully sponged. When any offensive vaginal discharge appears, the passage may be syringed with an antiseptic lotion. The bowels should be locked up for at least a week by small doses of opium twice a day, and then relieved by a dose of castor oil after some warm oil has been injected into the bowel; but, in some cases where union is thought to be feeble, it is well to keep them from acting for a longer period, care being always observed that no large indurated motion be allowed to pass, warm water and oily enemata being used.

Bowels to be locked up for two weeks.

Results.

With this attention good success generally follows, and women may have subsequent labours without any giving way of the parts.

Where much prolapse of the posterior wall of the vagina coexists, a strip of mucous membrane running up the vagina from the anal end of the recto-vaginal septum may be cut off, and the edges of the wound brought together. I have done this in many cases with an excellent result; indeed, in many cases of prolapse of the uterus, following some slight rupture of the perinæum, or even without, this operation is of great value.

Vaginal cystocele.

In vaginal cystocele a like operation is of benefit, the removal of a piece of vaginal mucous membrane at its labial border being often followed by a good result.

Dr. Kaspozilo in this operation catches the fold of mucous membrane to be removed, when drawn down, between the blades of a pair of long forceps; passes the sutures below the forceps, and finally cuts the mucous membrane away, and then ties the sutures.

Operations for prolapse.

Operations for Prolapse of the Uterus

are of great value, and consist, with certain modifications, of the removal of vertical portions of the posterior vaginal wall, though Marion Sims prefers the excision of an oval portion of the anterior.

Sims' operation.

To do Sims' operation the patient should be placed in the position for lithotomy, and the uterus or anterior vaginal wall near the uterus should be seized with a vulsellum or bullet forceps, and drawn well downwards. The surface of mucous membrane to be removed should then be marked out with a scalpel, and a piece from the neck of the uterus to the urethra, about three and a half inches long to two and a half wide, removed. All bleeding vessels should be twisted or tied with catgut, and the edges of this gaping surface brought together by alternate deep and superficial sutures, these sutures being introduced about a third of an inch apart. The wound should then be well washed with an antiseptic lotion, and the parts returned into the pelvis.

The stitches need not be removed for two or three weeks, and when carbolised gut is used they may be left alone to come away.

When a portion of mucous membrane is removed from the posterior vaginal wall there is no necessity to draw the uterus or vagina down, but a triangular (Hegar), five-sided (Simon's), perpendicular, or other shaped portion of mucous membrane should be removed, and the cut edges brought together, as in Sims' operation, the lower border of the flap, under all circumstances, corresponding to the junction of the vaginal mucous membrane with the skin.

In all these operations it is of importance that the bared surfaces should be clean and smooth, and that there should be no blood beneath the flaps.

Vesico- and Recto-vaginal Fistulæ.

Vesico- and recto-vaginal fistulæ.

Abnormal communications between the bladder or rectum and the vagina, are usually the result of long and tedious labour from sloughing of the tissues after too much pressure, although at times they may be caused by the rough use of instruments, the retention of a pessary, or the presence of a stone. They are, usually, discovered a few days after the delivery, by urine, wind, or fæces passing through the vaginal passage, these symptoms appearing on the separation of the slough.

The Surgeon is usually called upon to treat the case when the puerperal month has passed, and the patient's powers been restored; till then it would be rash to think of interference.

The operation for the cure of these affections is a very good one, and generally successful, failure following only in exceptional instances, that is, when the subjects are feeble, with small reparative power, or when the loss of tissues is too great to be made up.

Recto-vaginal fistulæ are more readily cured than vesico-vaginal, but both operations are alike in principle.

Operation for recto-vaginal fistula.

Operation.—Without going into its history, full details of which can be found in the special works on the surgical diseases of women, it may be said that it is to Sims and Bozeman, in America, and to Simpson and Brown, in this country, that the modern operation has been brought to its present state of perfection, although it is probably due to the introduction of anæsthetics that its great success is to be attributed.

Very small fistulæ may probably be cured by the actual or galvanic cautery, but every opening above the size of a crow-quill demands some plastic operation.

Objects in view.

In the operation, the Surgeon has three main points to observe:—

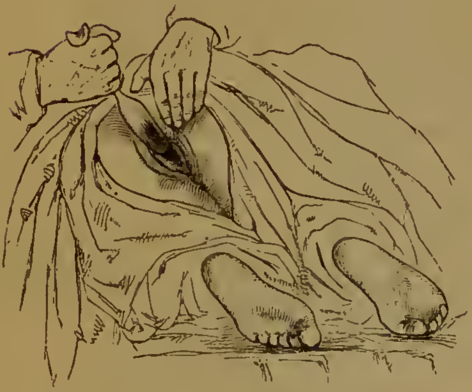
1st. To bring the fistula well into view and under control; 2nd, to pare with nicety and accuracy its whole margin; and 3rd, to bring into and maintain in apposition the raw and incised surfaces.

Speculum.

For the first object the duck-bill speculum is undoubtedly the best; by some authors it is spoken of as Bozeman's, by others as Sims'. It is both a dilator of the vagina and a retractor. Some Surgeons, Jobert being amongst them, talk of exposing the fistula by dragging the uterus externally and thus everting the vagina. I have never had the boldness to use sufficient force to do this, and cannot advise it. Such a measure would, however, greatly facilitate the different steps of the operation.

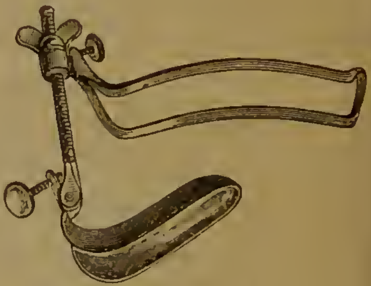
Weiss has recently so arranged the duck-bill speculum as to be self-supporting (Fig. 391). I have used the instrument and have been much struck with its value.

FIG. 390.



Position of patient for vesico-vaginal fistula.

FIG. 391.



Self-retaining vaginal speculum.

Operation for recto-vaginal fistula.

For recto-vaginal fistula the patient should be placed on her back, as in lithotomy, and for vesico-vaginal fistula this position is at times the most convenient; though I usually prefer the semi-prone position, the knees and thighs falling over the end of the table, the Surgeon looking down upon the fistula (Fig. 390). When the uterus is dragged down sufficiently far to evert the fistula, the lithotomy position is doubtless to be preferred.

Paring of edges.

The fistula having been brought well into view, the next step is to pare its edges, and in doing this the operator must not be too sparing of tissue; his aim being to obtain as broad and as clean a surface as he can. When this can be secured by means of a knife and forceps, no better instruments are required, the best knife being one that can be adjusted to any angle with rapidity and ease. When the fistula is high up in the vagina or large, the pronged guide (a modification of Hilliard's, of Glasgow) made for me many years ago is an excellent instrument (Fig. 392). It is readily applied and ensures a clean cut surface. Some Surgeons prefer the scissors (Fig. 392A).

When this step of the operation has been completed, the edges of the fistula must be brought together, and for this purpose numerous

Sutures.

devices have been employed. Splints of all kinds have been suggested, but with experience they have all been discarded, simple wire, silkworm-gut, or silk sutures, fastened with shot or otherwise, being preferred. I have tried every form of splint, and have at last come to gut sutures with or without shot fastenings, using occasionally a plaited fishing silk.

The sutures should be introduced tolerably close together, and at a good distance from the margin of the wound, say a third of an inch, and should not be drawn too tight. They should be fastened by running a perforated shot down over them, taking the precaution subsequently, to tie the gut over the shot to prevent its giving way. In this step, the operation is similar to that for fissured palate. In Fig. 393 the needles employed with the mode of introducing and securing the sutures may be seen.

Fig. 392.

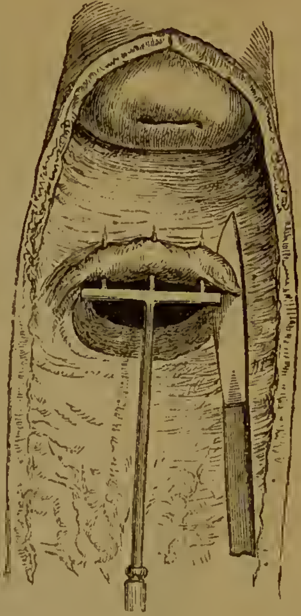
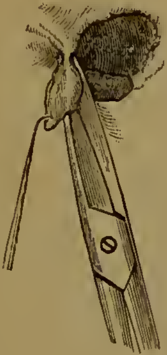


Fig. 392a.



Paring edges of vaginal fistula.

A good strong pair of forceps is required to nip the shot after they have been slipped into position.

When wire or gut is employed, Startin's hollow needles may be used, but the ordinary curved needles with good eyes at their ends are the best for silk. With wire, gut or silk, the shot fastenings are the best.

After-treatment.

After the operation, the vagina should be well cleansed of blood and the bladder emptied. Ice or iced water will generally arrest any bleeding that may ensue. An opiate suppository should be administered after the operation to give ease, and the same practice should be followed with respect to the bladder and diet as has been recommended after the operation for ruptured perinæum.

Use of catheter.

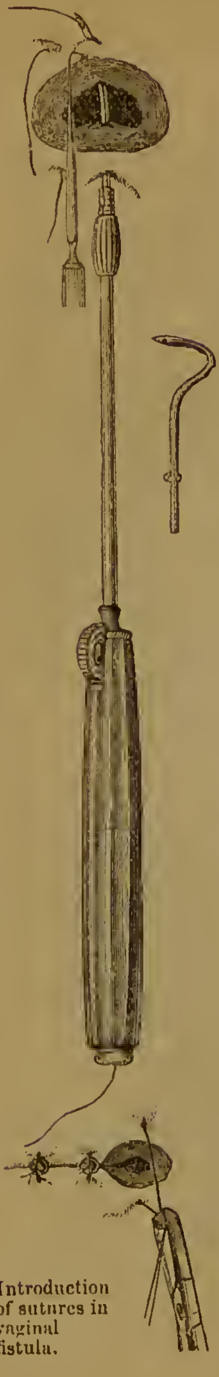
To leave a catheter in the bladder after the operation for vesico-vaginal fistula often adds to the irritation; its careful introduction at stated periods being preferable. When from circumstances this cannot be attended to, the introduction of a short catheter, with an open end to allow of the urine passing as it is secreted, should be employed. Dr. Meadows allows his patients to pass their urine in the natural way after the operation, and I have dispensed with the catheter in some cases without any bad result.

On the sixth or seventh day the sutures may be removed; but if good union has not taken place, and they are not causing irritation, they may be left in position for a longer period.

During the convalescence the vagina should be kept well cleansed by the daily use of some antiseptic lotion.

In recto-vaginal fistula the bowels should be kept locked up for

FIG. 393.



Introduction of sutures in vaginal fistula.

ten days or a fortnight, till the wound has firmly united, and then the fæces should be rendered soft by enemata of oil and gruel.

Splitting of the tissues.

When the tissues around the edges of the fistula are too thin to allow of their being pared, and, indeed, under some other circumstances, they may be split, that is, the vaginal mucous membrane may be raised from its submucous bed for half or three quarters of an inch round the fistula, and the under surfaces of the raised membrane brought together and held there by a quill suture. I have adopted this method on many occasions, and been most favorably impressed with its advantages. I was led to do so some years ago in a case of vesico-vaginal fistula where there was no tissue to spare, and was pleased subsequently to see so good a Surgeon as the late Mr. Collis, of Dublin, make the same suggestion. When this plan is adopted the sutures must be removed on the fourth day, otherwise the pressure of the bougie may cause ulceration. At times it is best only to cut the sutures, and leave the quills in position for a day or so longer—the amount of irritation they cause being the Surgeon's guide. Dr. Kidd and Mr. Mapother, of Dublin, have adopted, however, what appears to be a better practice. They make a U-shaped cut round the fistula through the mucous membrane of the vagina, raise the flap thus formed, and cut off its lower half, including the opening of the fistula into the vaginal mucous membrane. They then draw down the shortened flap over the fistulous opening into the bladder, and unite it by sutures to the crescentic border of the mucous membrane forming the bed from which the flap had been raised. The fistulous opening into the bladder is thus covered over with a flap of sound mucous membrane ('Brit. Med. Journ.,' June, 1872).

Dr. Kidd's method.

When neck of uterus involved in fistula.

When the neck of the uterus is involved in the fistula it may be necessary to lay it open; but when the uterus is involved it is more frequently necessary to turn the neck of the uterus into the bladder and close the vagina high up. In very extensive lacerations of the vesico-vaginal septum the Surgeon may be called upon to close the vagina nearer its orifice. I have done so on several occasions with good success, two or more operations being required.

When the fistula is surrounded by cicatricial tissue, and after the adaptation of its edges there is found to be much tension, lateral incisions through the tense mucous membrane are of great use in allowing the edges to fall rather than to be held together.

When fistula is surrounded by cicatricial tissue.

There must be no disease of the rectum.

In recto-vaginal fistula unconnected with parturition, before an operation is attempted, the Surgeon should satisfy himself, by a digital examination of the rectum, that no stricture or disease of the rectum coexists to which the fistula is secondary.

Vascular excrescences in urethra.

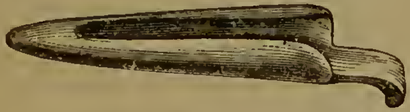
Treatment.

Vascular excrescences are very common in the female urethra, and from their great sensibility cause severe pain. They at times project from the meatus as a florid outgrowth, are often attended with a discharge of mucus, and at times of blood, also with irritability of the bladder. Their removal is the only sound treatment, and this can be effected by forceps and scissors, or by means of the galvanic cautery. When the former practice is followed the growth should be well drawn downwards and excised, a stick of nitrate of silver being applied to the base of the tumour to prevent bleeding. When any doubt exists as to its complete removal, chloride of zinc may be used.

When the urethra is the seat of more than one such growth, the introduction of a stick of sulphate of zinc at intervals of two or three days, may be followed by the withering of the growths; but when this result does not ensue the passage must be dilated and the growths removed. Nitric acid in some cases is a good caustic to ensure their destruction when excision or the galvanic cautery cannot be employed, and Dr. A. Edis recommends ('Brit. Med. Journ.,' April 4th, 1874) the saturated solution of chromic acid to be applied by means of cotton wool rolled round a stick to the growth until the surface becomes shrivelled.

To facilitate the use of any of these means, but more particularly the destruction of the growth with the galvanic cautery, I have found the use of the boxwood or ivory speculum and dilator depicted in Fig. 394 of great use. By it the urethra can be readily dilated, the urethral growth made to project through the aperture left in its side, and the whole tumour destroyed without doing any injury to the healthy tissues.

Fig. 394.



Speculum dilator for female urethra.

Polypi of bladder.

Polypi of the female bladder may protrude through the urethra, and put on the appearances of a urethral growth; but a complete examination of the urinary organs will prevent the Surgeon falling into any error of treatment.

Fibro-cellular tumours in urethra.

Fibro-cellular tumours at times grow in the urethra, and cause much local distress. I removed one which occupied the whole floor of the urethra to the neck of the bladder from a lady some years ago, with a good result.

Irritable bladder.

Irritable bladder in women is a very common effect of uterine disturbance or displacement, as well as of rectal disease. Such a symptom demands the closest investigation to ascertain its cause. It is mostly secondary to disease of the uterus, &c., and not often dependent on bladder affections. When difficulty in diagnosis is experienced the Surgeon should without hesitation make a digital exploration of the bladder.

CHAPTER XXVI.

DISEASES AND TUMOURS OF THE BREAST.

Sore nipples.

Prevention.

Sore Nipples are sources of great distress, and too often the precursors of mammary abscess. They are doubtless often caused by some aphthous condition of the child's mouth, but they as frequently result from some unusual sensibility of the skin of the part, and at times from want of care. In first pregnancies mothers should always harden their nipples by the daily use of some spirit lotion, or eau de Cologne and water, and where they are not sufficiently prominent a breast glass or gutta-percha shield, such as that sold by Elam, of Oxford Street, should be worn, as nothing tends more than these means to prevent this troublesome affection.

Treatment.

Applications.

Mode of drawing out the nipple.

When sore nipples occur at the time of suckling, the same shields should be worn, great care being observed to dry the nipples after use, and never to leave them in the child's mouth after the process has been completed. The application of the glycerine of tannic acid, Richardson's styptic colloid, tincture of catechu, a solution of nitrate of silver, gr. v to the ounce of water, or an ointment of extract of rhatany, gr. viiij mixed with ʒij of the oil of theobroma, are good applications. Castor oil as an external application, or collodion, is sometimes useful. When cracks exist it is a good plan for the mother to draw out the nipple by means of the old-fashioned feeding bottle before giving it to the infant, the mother's nipple being put into the central opening, and her mouth drawing the artificial one. Another ready method is the application to the nipple of the mouth of a wide-necked empty bottle that has been heated by hot water, the nipple, as the bottle cools, being pressed into the bottle, and rendered prominent in a painless way.

Engorgement of the breast.

Engorgement of the breast takes place when, from any cause, a woman is unable to give suck, either from defect or disease of the nipple or the death of the child. Under these circumstances the gland may become tense and distended, and, if left unrelieved for twenty-four or thirty-six hours, will probably inflame. When the gland, however, can be relieved by the application of an infant to the nipple, or, next best, by a bottle in which a partial vacuum has been made by means of hot water, the mother's mouth, or a *very carefully* applied breast pump, the engorgement may subside, and no harm accrue.

Pressure.

Belladonna.

Pressure should then be employed by means of strapping, which must be applied over the gland, previously smeared with the extract of belladonna, rendered liquid with an equal part of glycerine. A saline or other purge is often of value, with some tonic medicine as quinine—a mixture of two or three drachms of the sulphate of magnesia and one or two grains of quinine, two or three times a day being as good as any.

Friction.

In lobular engorgement of the breast gentle friction is of great value, with or without oil, and warm and moist applications are also most useful.

INFLAMMATION OF THE BREAST.

Inflammation of the breast.

This may appear either as a *subcutaneous* more or less extensive periglandular abscess, a *local* phlegmonous lobular inflammation, or a *diffused* abscess throughout the whole gland. It may primarily involve the connective tissue which exists between the lobules, as well as the true secreting structure of the gland; it may likewise occur behind the gland.

It may be *acute* or *chronic* in its nature; it may run its course without any breaking up of tissue or suppuration, or be attended with most destructive local results; the extent of destruction of tissue depending upon the severity of the inflammatory process, and the amount of constitutional power of the subject of the disease. As a rule, however, suppuration takes place.

"When the mamma, in its state of full expansion and perfect functional activity, becomes the subject of an interference, the result is very commonly a diffuse or nodular inflammation and the formation of an abscess. A sudden stoppage of the milk soon after the lactation has been established is apt to produce inflammation, and the same result, or a degree of it, sometimes follows the weaning of the child after a long course of suckling. The disturbing cause, whatever it may be, acts upon the mamma when its function is at its greatest intensity, and the characteristic effect is inflammation and abscess."—*Creighton.*

Inflammation usually during state of activity. Statistics.

In a general way inflammation attacks the breast gland when in a state of activity; and it is exceptional for the passive organ to be the subject of this process. Out of 102 consecutive cases under my observation, 79 occurred during lactation, 2 during pregnancy, and 21 in patients who were neither suckling nor pregnant. Three fourths of the cases that occurred during lactation attacked patients during the first two months; and in many of these a cracked nipple was the assigned cause; but I am disposed to think with Mr. Ballard, that abscess in the early months is due to the searching of the child after milk before the gland is filled, in patients who have neither sufficient power to secrete milk, nor to resist the inflammatory process when once originated. The affection is more common in primiparæ, and the right breast is more frequently affected than the left in the proportion of five to three. In some cases the rapidity of the process is very marked, an abscess forming within a few days, while in others it is most insidious; chronic abscesses have been often mistaken for new growths, and amputation of the gland performed under this false diagnosis.

Abscess in infants' breasts.

Abscesses occur in *infants' breasts*, and they are too commonly the consequence of an ignorant nurse applying pressure to the glands in which milk is found, or friction to "rub away the milk." The milk appears to be more abundant in the male than in the female infant.

They are also met with in the male subject from injury or other causes.

Chronic mammitis in the young.

Chronic Mammitis in the boy or girl, is by no means a rare affection, the undeveloped gland becoming indurated and very painful; such cases rarely suppurate.

Treatment of inflammation of breast.

TREATMENT.—The activity of the treatment of the affection we are now considering must be regulated by the acuteness or severity of the inflammatory process, and the nature of the constitutional and local symptoms to which it may give rise. As a broad truth, it may be confidently asserted, that the inflammatory process is of a low type and of a destructive nature, and, that as the constitutional powers are generally feeble, nothing like lowering measures should be adopted, but, on the contrary, soothing local applications and constitutional tonics with sedatives are absolutely demanded.

During lactation.

In cases occurring during lactation no other principle of treatment than those I have just laid down should be entertained. Under such conditions, soothing fomentations to the breast, either of warm water or some medicated solution, such as the decoction of poppies, give most relief, although a light linseed poultice or some spongiopiline may be well employed. In young, robust women, where suckling is impossible, the application of laxatives and powerful purgatives may be called for.

Rest.

Tonics.

Sedatives.

Rest in the horizontal position affords striking comfort, and, when it can be carried out, is of great practical advantage; but, if this desideratum cannot be secured, the whole breast must be supported by a band or linen sling. During this time, tonics in such a form as can be borne and may be indicated should freely be given, quinine probably being the best. Such stimulants as wine or beer must be cautiously administered, though the cases are few which do not require such an addition to their diet, while plenty of nutritious food should be allowed. A sedative at night is also very generally required, and Dover's powder in ten-grain doses is the best form, for want of sleep from pain is a common accompaniment. A mild purgative in the early stages of the disease may be necessary, but excessive purgation should be avoided, since the object of the Surgeon is to supply power, and not to remove it—to soothe and not to irritate.

On the opening of a mammary abscess.

Incision to radiate from the nipple.

On opening a Mammary Abscess.—There is a great difference of opinion among Surgeons about the propriety of opening a mammary abscess. Some think the best practice is to let the breast alone, and leave the operation to nature; while others advocate an early opening. But in neither am I disposed to coincide, for while I regard it as a right practice to postpone puncturing the organ as long as possible and not to show any over-anxiety in evacuating the pus; on the other hand, I know that when the abscess is left to itself much unnecessary suffering is endured and a considerable sacrifice of skin often follows, entailing a long convalescence and an ugly cicatrix. The practice I consequently generally adopt is to leave the parts alone till pointing has taken place and then to puncture, making my incision in a line radiating from the nipple of the patient. By adopting this practice, any unnecessary pain is saved, for the appearance of pointing is directly under the observation of the Surgeon, and it is not necessary to make frequent and careful physical examinations. Of course, some gentle manipulation is absolutely called for to enable the Surgeon to form an opinion, but the eye and not the finger is the chief guide. Much manipulation of the gland is both painful and injurious, and an absolute abandonment of all local surgical treatment can only be condemned.

Warm applications.

Warm fomentations in all stages of the disease are very grateful to the patient, and may be freely used; and when early suppuration threatens, a light linseed poultice is probably the best application. When the abscess has discharged, the poultice may be laid aside, and some antiseptic application employed, as constant poulticing soddens the integument and retards the process of convalescence.

On the Treatment of Chronic Abscess of the Breast.

Treatment of chronic abscess of breast.

The existence of a chronic abscess having been made out—a point, by-the-bye, which will be returned to when the subject of the diagnosis of a mammary tumour is discussed—it becomes an important question what treatment should be pursued.

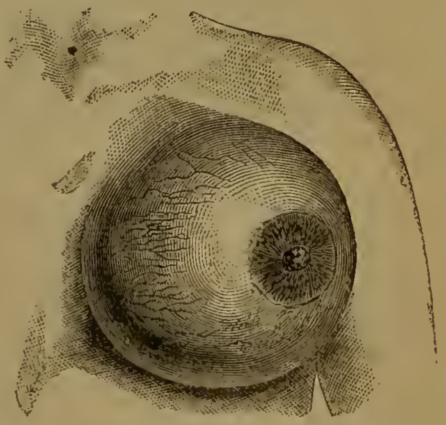
Pressure.

When the abscess is small, causing little or no annoyance, it may be left alone, and under the influence of tonics and local pressure by means of strapping, the fluid may be absorbed, and such a result is occasionally brought about. In the majority of examples, however, some more active treatment is necessary, and of these the evacuation of the pus is the chief point. If the abscess is large and deeply seated—a common condition—the drawing off of its contents by means of a trocar and canula is the usual practice and is generally believed to be the best; but it has this disadvantage, that the wound generally soon closes, and a second operation is required. The same treatment may be again resorted to with the same results, and this drawing off of the pus and the subsequent closure of the wound may go on for many times. At last, however, the opening remains patent, and the abscess contracts, leaving a sinus in the majority of cases. Under these circumstances, a bolder plan of treatment seems absolutely demanded, as time is an important element in the consideration of any plan of treatment. The best method appears to be a free opening at the first operation, the Surgeon subsequently inserting a strip of oiled lint into the cavity of the abscess for a few hours to prevent the wound closing.

Evacuation of the pus by trocar.

Free incision.

FIG. 395.



Submammary abscess.
Drawing 401⁴³, Guy's Mus., Birkett's case.

Submammary Abscess.

On submammary abscess.

Abscesses occasionally form *behind* the breast gland over the pectoral muscle, and when they do, the gland is pushed forward in a way that is characteristic. The abscess (Fig. 395), as a rule, points below the breast. Such abscesses should be opened in the most dependent position as soon as any indication of fluctuation can be made out. This disease is very slow in its progress.

On the treatment of Sinuses.

Treatment of sinuses.

The treatment of sinuses in the breast, as elsewhere, is always a task of difficulty, and in certain cases all plans will fail. The one principle of practice which seems to be the most valuable is the establishment of a dependent outlet; and for this purpose the introduction of a drainage tube is a simple and successful practice. If there are many sinuses, some pressure may be employed by means of strapping, care being taken that the openings are left uncovered to ensure a free passage for the discharge. Superficial sinuses may be slit up, when other means fail, and in very chronic cases some irritant, such as iodine, may be injected, to excite a fresh action. The great principle of practice in these cases, however, appears to be that to which I have already alluded, although other means may at times be demanded.

Chronic Induration of the Gland.

On chronic induration of breast.

This affection occurs when, from some cause or other, the gland is morbidly excited. It is chiefly found in unmarried women between the ages of thirty-eight and forty; though it occurs in the married, and then, as a rule, in the sterile. It is usually associated with some catamenial irregularity or some general disturbance, more particularly of the nervous system.

Symptoms.

The affection is known by the excessive sensibility of the indurated gland on manipulation, the nervous excitement the examination causes, *the total absence of any local indications of a tumour when the fingers are placed flat upon the part*, and the induration of the gland, or lobe of the gland, when the organ is raised from the pectoral muscle and pinched.

Treatment.

The *treatment* consists in correcting what is wrong in the general condition of the patient by means of iron, tonics, and alteratives, and soothing the affected part. Cold lotions are at times grateful, while at others a belladonna plaster affords relief, with or without pressure. Large breasts should be suspended, and all should be protected by cotton wool from the risks of injury.

On irritable mamma.

The irritable mamma of young girls is closely allied to the affection just described, and is associated with a morbidly sensitive condition of the mammary gland and parts around, and often with some induration. It is an affection closely connected with the pelvic generative organs which are mostly found to be not acting fairly, as indicated by catamenial irregularity, &c. This condition is, doubtless, at times excited by depraved habits. It should be treated on the same principle as the last affection.

ON TUMOURS OF THE BREAST.

Tumours of the breast may rationally be accounted for by following out the functional aberrations of the organ, and in proof of this the student should study carefully the highly suggestive and valuable work of Dr. Charles Creighton,[1] who has shown that "the investigation of breast tumours reveals merely the working of the physiological law of healthy mammary activity under altered circumstances, that various degrees of disordered function may result in various kinds of tumours," and that tumour disease of the breast is "essentially a disorder of function."

Dr. Creighton's views.

The breast, in passing from its "resting" or inactive state to that of full activity, undergoes during the entire period of pregnancy a process of "evolution," which is characterised in its different stages by certain cell changes within its acini and transport of cells without; and, in the return of the gland to its quiescent condition, on the subsidence of lactation, a process of "involution" in which a parallel series of changes acting in an inverse order is to be observed, the functional subsidence of the gland being spread over a shorter period of time than its gradual awakening during pregnancy.

Evolution of gland.

Involution of gland.

Lowest stage of action.

When the functional stimulus of the mamma is acting at its *lowest* point at the beginning of "evolution" or the ending of "involution," the secretory products are large granular yellow pigmented cells, which are found within the secreting acini, in the connective-tissue spaces outside the secreting structure, and likewise in the lymph-sinuses of the subjacent lymphatic glands, these cells being the waste products of a feeble degree of secretory activity; and, if the mammary excitation were always to act at that degree of intensity, the secretion it may be said would always be in the form of large granular pigmented cells.

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[1] 'Contributions to the Physiology and Pathology of the Breast,' 1878.

Intermediate stage.

At the *next appreciable advance* in the intensity of the stimulus, the product formed in the gland may be described somewhat generally as a large granular nuclear cell, which is nothing else than the crude epithelium of the middle period of the breast's unfolding, in which an imperfect secretory force resides.

When stimulus is at its height.

Coming *still nearer to the full excitation,* the cellular ingredients are fewer and the mucous production much more abundant, and finally, when the *stimulus is at its height,* the mucous fluid has given place to a fatty fluid, and whatever cellular elements the secretion contains are the well-known colostrum cells, which approach most nearly the perfect secreting cell. The periodical unfolding of the breasts, which is an obvious accompaniment of each pregnancy, is thus characterised by a progressive series of immature secretory products, which necessarily run to waste. The epithelial cells are not transformed into milk till the time of delivery and during the period of suckling following; but the functional action of the breast has been at work all through the pregnancy, and has advanced in intensity just as the secreting structure has advanced in its unfolding. The various stages of unfolding have corresponding secretory products, becoming less and less crude, and, as there is a similar series of more rapid but exactly parallel waste products in the upfolding, it is a legitimate inference to ascribe "a special kind of secretory product to a certain degree of intensity of the glandular force."

When breast is disturbed in disease.

When the breast gland is disturbed from its resting state by a cause other than pregnancy, and, in consequence of some morbid excitation, is urged into a kind of evolution process, the steps of its unfolding are less orderly than in the normal evolution, and the "spurious excitation" never carries the gland to the end of its unfolding or to the perfect degree of its function. And, although the morbid excitation may be said to correspond in its intensity to a stage of the normal evolution, there is this fundamental difference, that the corresponding stage of the normal process is transient, giving place to a stronger force while the morbid process continues indefinitely at the same enfeebled level. As a consequence, the cell that should have been thrown off from the acinus as waste almost as soon as it was formed, remains in the place of its origin to multiply, and, with its progeny, to infest the glandular structure of the breast either as intra- or extra-acinous accumulations. Indeed, according to Dr. Creighton, it is upon deviations from the physiological track such as these that the existence of a tumour depends.

How tumours form.

Thus "a circumscribed tumour arises at a particular part of the gland where the spurious excitation has advanced to a certain stage of evolution or unfolding; in that particular region, probably a territory defined by the blood-vessels, the functional force has acted at a uniform imperfect level for a length of time, the inevitable cellular waste of the crude secretion has accumulated within the acini or around them, and the foundation of a tumour has been laid.

In the healthy action of the organ there is a provision for the disposal of the very considerable amount of cellular waste material by means of the neighbouring lymphatic glands. In passing from the secreting acini and in traversing the stroma of the gland, the waste cells often acquire a spindle form; and although these cells are not always distinguishable from the connective-tissue cells of the part, there is, especially in the bitch, a class of pigmented epithelial cells in which such changes of form and position can be clearly traced. The spindle-shaped waste products are the type of the peri-acinous cell-collections in cystic or adeno-sarcoma.

So far as relates to the large nuclear cells, the *intra*-acinous collections of them correspond to the structure of medullary cancer, and the *extra*-acinous infiltrations of the same cells are a distinguishing feature of scirrhus. "The distinguishing feature of the less malignant form of tumour is that the spurious *functional* activity comes nearer in the degree of its intensity to that of the perfect secretory *force*, the transformation of the epithelium is a more real transformation, and the cellular waste is reduced, in part at least, to the class of fibre-like or crescentic elements that characterise the myxomatous and more benign issues of the tumour process."

"The circumstance that the unknown diseased excitation most commonly befalls the gland when it is in the state of rest is of the first importance in accounting for the formation of a tumour. Whether the disturbance be a mechanical injury, or a sympathy with excitement in the ovaries, or of a more general emotional nature, it comes upon the breast in its resting state. The breast can react in no other way than by following the somewhat slow process of its normal evolution; without the intermediate stages of unfolding it cannot reach the perfect degree of its functions in which there would be immunity from danger. The intermediate stages are necessarily associated with the formation of crude cellular products; it is at one or other of the intermediate stages that the morbid force delays, and the corresponding cellular secretion of the gland thereupon assumes the character of a formative or tumour process."

"The circumstances of the functional disturbance are never exactly the same in any two cases, consequently, the respective modifications of structure, or in other words, the structure of the respective tumours are never exactly the same."

When a tumour forms in the breast within the period when the function may still be awakened to its full and healthy vigour, that is, during the period of its structural and functional maturity, a resolution of the disease or a dispersion of the diseased products may be looked for. But when it appears at or near the climacteric years, when the gland is suffering an effacement of its secreting mechanism and a withdrawal of its secretory force, no such a result can be expected, and it is at this period that the greater number of intractable tumours occur.

"It is the climacteric effacement of the breast that gives a peculiar character to the disease in women, and there are well-marked structural differences in the tumours according as they appear before or after that period. Those that develop after the climacteric years are perhaps the most common, as they are certainly the most intractable, and they have been the real source of ambiguity in the pathology of the organ. That ambiguity depends upon the circumstance that they occur in an organ which is gradually losing or has lost its characteristic structure." Where the normal itself is vanishing, the departures from the normal are elusive.

It seems probable, therefore, from Dr. Creighton's investigation, that the adenomata, sarcomata, myxomata, and carcinomata have their type in a series of progressive changes which the gland undergoes in its physiological evolution. The feebler the intensity of the function, the more cancerous the disease; the higher or more advanced the evolution from the resting state, the more benign the tumour.

The Clinical Examination and Diagnosis of a Breast Tumour.

From a practical point of view, tumours of the breast may be divided into "*inflammatory*," "*adenoid*" or innocent, "*cystic*," "*sarcomatous*," and "*cancerous*." Simple hypertrophy or excess of growth of the gland can hardly be classed among the tumours.

On the diagnosis of tumour of the breast.

Is there a new growth?

The first point a Surgeon has to determine when consulted by a patient who has "something the matter" with her breast, is practically the existence or non-existence of a tumour, *i.e.*, is there a new growth developed behind, and in connection with the mammary gland? or, is the disease from which the patient is suffering situated in the substance of the glandular structure itself? This first and most important question ought to be solved before a further step can with safety be taken; before the formation of a correct diagnosis of the case can be made; and it is quite impossible to magnify its importance. To do this, however, considerable care is necessary, and some manipulative skill must be called into requisition; as a careless examination will surely end in an uncertain diagnosis, and with this, a failure in treatment. In examining a breast, therefore, with diagnostic intentions, the Surgeon with the whole gland well in view, should place the palmar surfaces of his fingers over the suspected spot, and taking the gland in his hand manipulate it gently and in every part with his fingers and thumb; when, if an isolated tumour can be found, he will in all probability detect its presence; if, however, he is uncertain upon this point, he should make the patient lie down, for "if a patient be sitting or standing, and the breast is grasped by the finger and thumb, when induration of the gland itself exists, a sensation is felt as if a tumour were present. If, now, the palmar surface of the fingers be pressed flatly against the chest in the same part, nothing remarkable will be distinguishable. If a tumour or new growth exists, however, it is immediately perceptible. But if a doubt arise in the matter, the patient should recline when under examination; and then, if there be a tumour, it is immediately manifest to the touch, and often to the eye."—*Birkett.* Having then detected the presence of a tumour, that is, an independent growth developed in the neighbourhood of the breast-gland and probably in connection with it, the question arises as to its nature. Is it a simple or a malignant tumour? If the tumour be movable and hard, if quite free, or if it has but a very uncertain connection with the gland structure, there is a strong probability that the tumour is of a simple nature; and, if it has existed for several months, this probability becomes stronger, for the *cancerous* tumour has a tendency even when primarily developed as a tuber or as an independent structure, to associate itself and become connected with the neighbouring tissues by an infiltrating process; and if this

Mode of manipulating

Birkett's method.

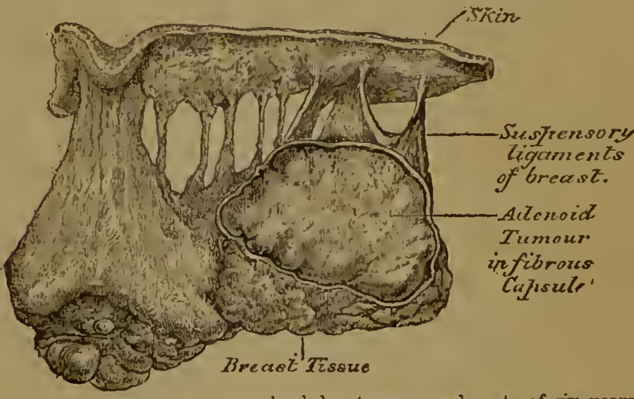
Diagnosis of adenocele.

has not taken place, the absence of these conditions enhances the probability of the simple nature of the growth under examination. If the patient is also young and healthy, and no other abnormal conditions, either of the breast or neighbouring structures are to be detected, the probability becomes a certainty, and the presence of an "adenocele" may be determined on—this tumour being synonymous with the chronic mammary tumour of Sir A. Cooper, the mammary glandular tumour of Paget, the sero-cystic sarcoma of Brodie, the adenoma of Birkett, or the fibroma of Gross.

Symptoms of adenocele.

These *adenoceles* are found as a rule in the young and unmarried, and in the apparently healthy and robust, although occasionally they occur in the aged. They appear during the period when the procreative organs, and among them the mammary glands, are in a state of "developmental perfection;" and when they occur in married women, are most frequently developed during pregnancy or suckling. They are never associated with any other symptoms than such as can be produced mechanically by their presence, and never involve the integument except by distension; nor is the skin ever infiltrated by any new material. They are never accompanied by any secondary enlargement of the absorbent glands nor associated with any secondary deposits; they cause no cachexia and do not undermine the health; but affect the patient solely through local influences, and demand treatment chiefly from local considerations. They may be found in either breast, occasionally in both, and are constantly multiple, two or more tumours being often found in the same gland. In Fig. 396 the way the growth attacks the gland as an encapsuled tumour is well illustrated.

FIG. 396.


Skin
Suspensory ligaments of breast.
Adenoid Tumour in fibrous Capsule
Breast Tissue

A succulent and fibrous mammary glandular tumour and cysts of six years' growth, taken from S. A. P—, a single woman, æt. 26. The drawing exhibits a section of the new growth and a piece of mammary gland. The growth is enveloped by a fibrous capsule continuous with the suspensory ligaments of the breast. Prep. 2292^{6}, Drawing 410^{50}, Guy's Museum. J. Birkett.

Statistics.

From my notes of eighty-one cases consecutively observed—

22 appeared under the age of 20.
28 between 21 and 30 years of age.
18 „ 31 „ 40 „
11 „ 41 „ 50 „

2 above the age of 50.
37 were in single women.
31 in the married and prolific.
12 in the married and sterile.

May remain small.

As long as these tumours remain small and quiescent, they are of

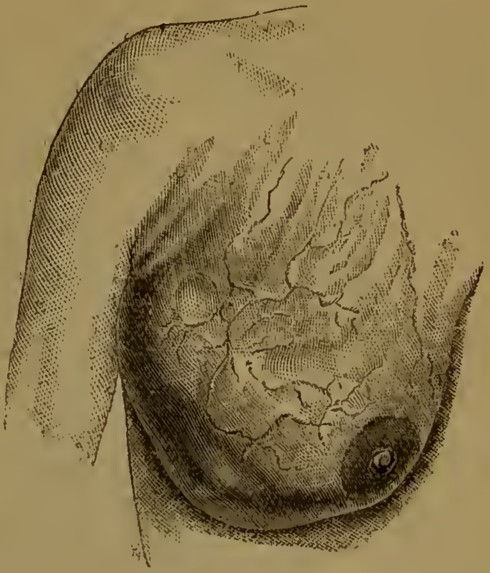
May increase and cause pressure.

Characters of adenocele.

Adenocele a local affection.

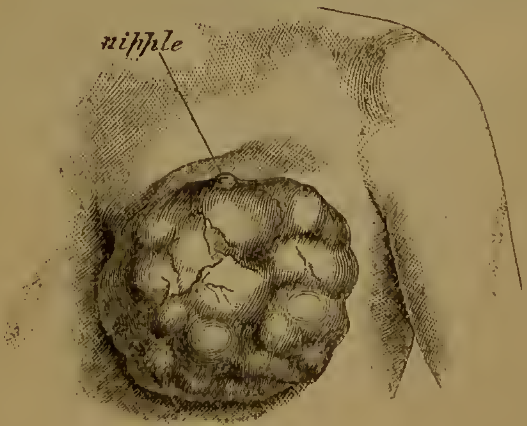
little importance; and, being movable, are readily diagnosed; but when years have been allowed to elapse, and their growth has increased, and, from their greater size they have become burdensome and press on neighbouring structures, they are neither of small importance nor are they readily to be distinguished. But yet, if careful observations are taken, an error in diagnosis should not be made. For, although the breast itself may be much pressed on or even expanded over the tumour, it will still exist, and, on careful examination, its presence, as a rule, will be made out. The nipple, although flattened from the extreme glandular expansion, can still be seen (Fig. 398); and is rarely retracted. The integuments may be stretched to an extreme point, yet will they still be movable and sound (Fig. 397, also Plate V, Fig. 2), although some inflammation from over-distension may have made its appearance, and large veins are always to be observed meandering in the healthy tissue. The tumour, if solid, may appear lobulated (Fig. 398), and if containing cysts, fluctuation may be detected. Still, the disease is essentially a local one, and affects the patient through purely local conditions. It is to be treated only by excision, and the gland, as a rule, should be left unharmed, the tumour being turned out of its capsule. In extreme examples, however, the breast is so stretched out as to be useless, and then must be removed. In the patient from which Fig. 398 was taken, this

Fig. 397.



Cystic adenocele.

Fig. 398.



Solid very lobulated adenocele of six years' growth, taken from A. S—, æt. 35.

was the case. She was a woman, æt. 35, and the tumour was of six years' growth.

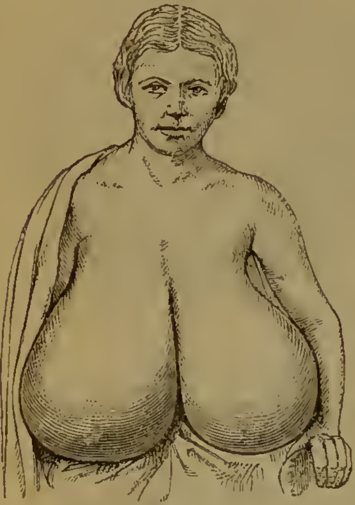
Diagnosis of tumour caused by partial or general enlargement of gland, &c.

The Diagnosis of a Tumour which is evidently caused by some partial or general enlargement or infiltration of the Mammary Gland.

Let us suppose that the Surgeon has a case of disease of the breast before him, in which the structure of the gland is itself involved, and there is no independent movable tumour, such as we have been considering; but that on manipulation it is evident the growth, whatever it may be, is intimately connected with the gland structure.

What is the case? Have we an inflammatory affection only of the organ, or some hypertrophy or innocent enlargement? Is it a simple or a malignant disease? When the manipular indications of the mammary gland are those only of enlargement, is such a condition due to pregnancy, or the product of a simple hypertrophy, confining the meaning of that term to an excess of growth?

Fig 399.



Hypertrophy of breast.

Hypertrophy.

If the increase be due to hypertrophy, which is a somewhat rare condition, it will have been to a certainty of a chronic nature, its increase slow and growth painless. The gland will appear simply enlarged, with no increase in action beyond that which growth demands, although this increase in growth may be very great. It is found mostly in young women, but I have seen it in the male; at times it affects only one gland. In the case from which Fig. 399 was taken each gland on removal weighed about fourteen pounds. I saw the case some years ago with my friend Mr. Shipman, of Grantham. The breasts were subsequently removed by Sir W. Fergusson.

Hypertrophied breasts do not secrete milk.

Breast does not secrete milk.

That the affection is something more than a mere increase in the growth of the gland is proved by the fact that, in a female patient of mine, æt. 43, who had this disease in her right breast of thirteen years' growth, and not in her left, and had a child, no milk was secreted in the diseased gland, while in the sound one there was abundance.

Pregnancy.

If the enlargement be due to pregnancy, there can be little difficulty in the diagnosis, for it is attended with an activity of the local circulation, a general fulness of the gland, an enlargement of its veins, and a darkening of the areola, which will not fail to excite suspicion. Besides this, *both glands* will be similarly affected, a coincidence which is rarely seen in any morbid condition. The very suspicion of pregnancy, however, will be enough to call attention to other points, by which a solution of the difficulty can be obtained.

Chronic inflammation and cancer.

Is the enlargement to be explained by any inflammatory condition? I do not mean an acute inflammatory condition, for such an affection has features which are too characteristic to allow any mistake in diagnosis being made, but is the infiltration of the gland to be explained by some chronic inflammatory change, such as is so frequently found in the female breast; or is it the early stage of an infiltrating cancer? The answer to this query is not always easy. In middle-aged patients, when cancerous affections may be looked for, the presence of an indurated mammary gland, wholly or in part, must always be regarded with suspicion, and, if the case be recent, I believe it to be an impossibility to form any certain opinion as to its true nature. If the induration of the gland be the only symptom, and is associated with a sharp or even dull pain, either a simple chronic inflammation of the gland may be indicated or the early condition of a cancer. If, however, much time has already passed, say many months, and no other symptoms have made their appearance, there is some ground for the hope that the enlargement may be due to inflammation, since infiltrating cancers are not generally inactive—are not stationary, as a rule—and soon give rise to other symptoms, such as some, though it may be slight, enlargement of the absorbent glands; some slight dimpling (Plate IV, fig. 1) or puckering of the skin, an important sign (Plate IV, figs. 2 and 3); or some more marked symptom, such as infiltration of the integument or a retracted nipple. It should be remembered, however, that a retracted nipple is only an accidental symptom, such as may be caused by several conditions, and is not by any means of itself characteristic of cancer. But if any or all of these symptoms show themselves soon after the first appearance of the lobular enlargement of the mammary gland, an opinion as to the cancerous nature of the growth may be confidently expressed. If, on the other hand, none of these symptoms make their appearance, and the induration or infiltration of the lobes of the gland remains stationary, or shows some tendency towards improvement, the probability of the simple character of the disease gains ground. When this induration of the mammary gland appears in a *young subject* there will be no reason to suspect a cancer, and it should rather be regarded as the result of some slight inflammatory effusion. Under such circumstances there will generally be some increase of pain after examination, but an absence of any other local symptom. There will probably be some irregularity of the catamenia, and some signs of general excitability of the patient. But, as a local affection, there will be only the one symptom of induration of one or more lobes of the mammary gland, which, *in the absence of all other signs*, may with safety be regarded as inflammatory. The same argument holds good when the disease appears at a later period of life, although suspicions of a cancer should rightly be excited; still, the positive diagnosis must be postponed till, by the lapse of time, some other symptoms, such as those already mentioned, make their appearance, to clear up all doubt, or by their absence prove the innocent nature of the affection.

When may be considered as a simple growth.

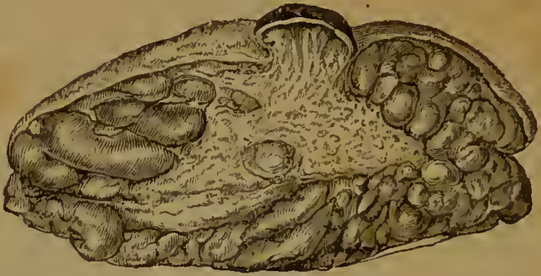
Carcinoma of the Breast, or Cancer.

On cancer of the breast.

This affection is found either as an *infiltration* of the gland, wholly or in part (Fig. 400 and Plate IV, figs. 1, 2, and 3), or as an independent tumour or tuber within the meshes of the gland—*tuberous cancer* (Fig. 401 and Plate IV, fig. 4). It may likewise be met with associated with cysts—*cystic cancer*, this being only a variety of the other forms.

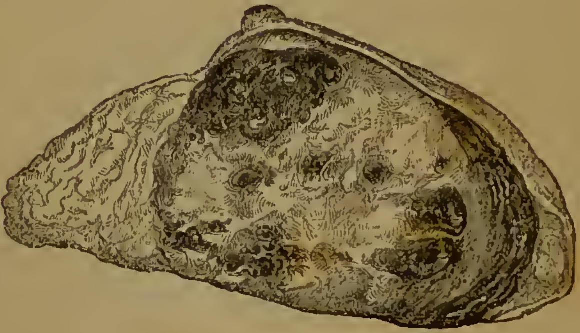
Infiltrating. Cystic.

Fig. 400.



Infiltrating cancer of the breast. Drawing 409^{18}, Guy's Mus., Birkett's case.

Fig. 401.



Tuberous cancer. Birkett's case.

On the infiltrating cancer: its characters.

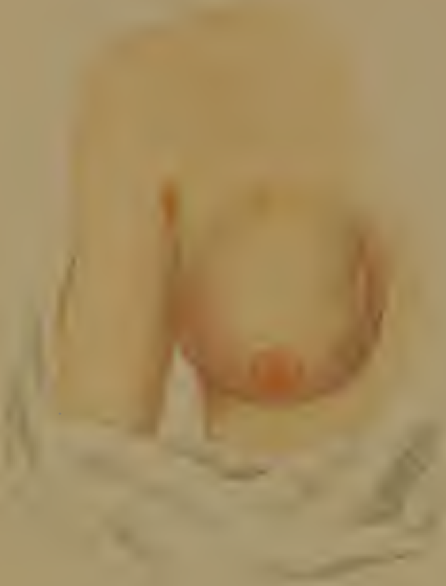
In the infiltrating form the gland appears hard, inelastic, and incompressible; as the disease progresses it seems to contract, and to draw all the parts around together, and gradually to infiltrate them. In this way the nipple often becomes drawn in or to one side. At times, after having been drawn in, it becomes infiltrated with the disease, and becomes again prominent; at others, by the contraction of the gland, it may be strangulated, become œdematous, and then slough off. The skin is at first dimpled, then puckered, and at last infiltrated. The breast also, from being a movable organ, becomes fixed; so fixed, indeed, that it cannot be separated from the pectoral muscle.

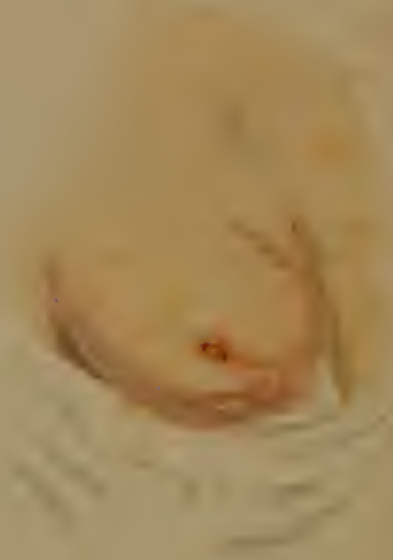
Retracted nipple.

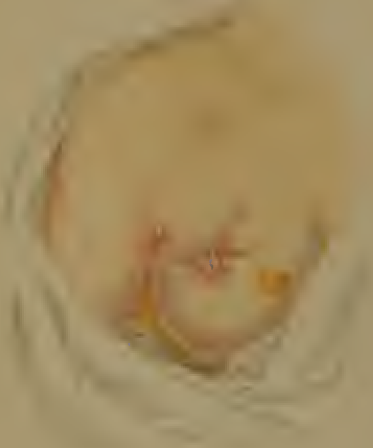
Its progress

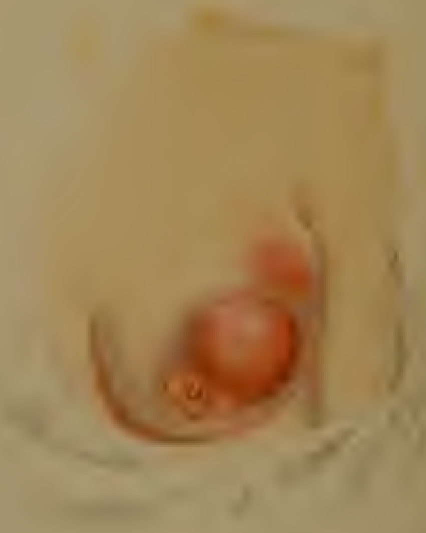
This form of cancer is the more common. The disease may appear in one lobe or in all, and be slow in its progress or rapid, but in every

PLATE 4









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DESCRIPTION OF PLATES IV & V.

THE following Drawings illustrate in order the Five most important Clinical Features of Cancerous Disease of the Breast.

1st.—**The Early Infiltration of the Breast,** as shown by an enlargement of the whole, or of one lobe, of the gland.

2nd.—**The Dimpling of the Skin** (Fig. 1), due to the shortening of the suspensory ligaments of the breast (*vide* Fig. 396, page 266).

3rd.—**The Puckering of the Skin** (Fig. 2), brought about by a still greater shortening of the suspensory ligaments of the breast and an early infiltration of the skin.

4th.—**The Infiltration of the Skin** (Fig. 3) and Formation of a Skin Tumour, with marked puckering and early ulceration of the skin.

5th.—**The Breaking Down** of the Cancerous Growth and appearance of a Cancerous Ulcer. Fig. 1, Plate V, of a tuberous, and Fig. 405, of an infiltrating cancer.

FIG. 2 shows the **Retraction of the Nipple,** so frequently present in cancer (*vide* Fig. 400, page 270); whilst in Figs. 1, 3, and 4, such a symptom is absent.

FIG. 4, Plate IV, gives the external appearances of a **Tuberous Cancer of the Breast;** as Fig. 401, page 270, illustrates a section of the same.

PLATE V.

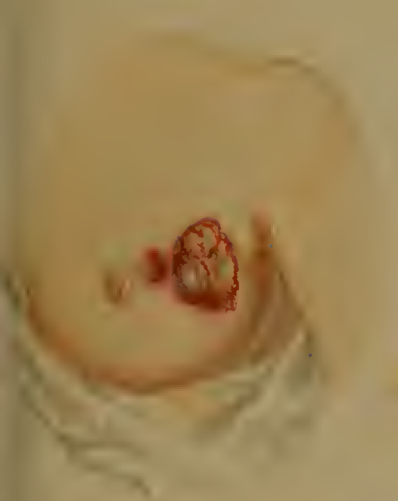
Fig. 2 illustrates a case of **Adenoma of the Breast**, with the skin stretched over it.

Fig. 3.—**A Cystic Sarcoma of the Breast.**

Fig. 4.—**A Cystic Sarcoma of the Breast**, with an intracystic growth bursting through the skin which covered it.

PLATE 5

1



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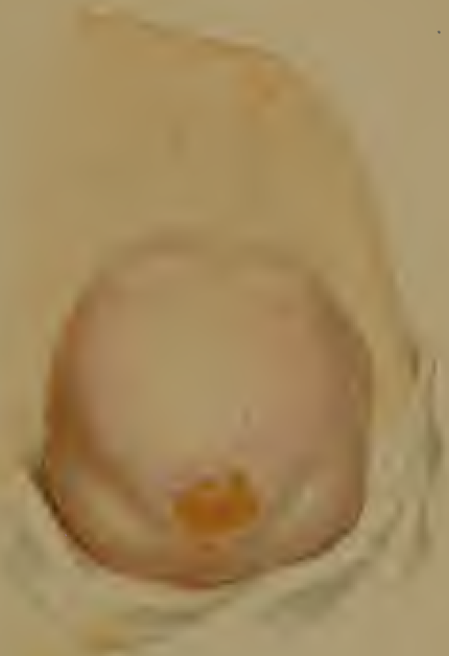

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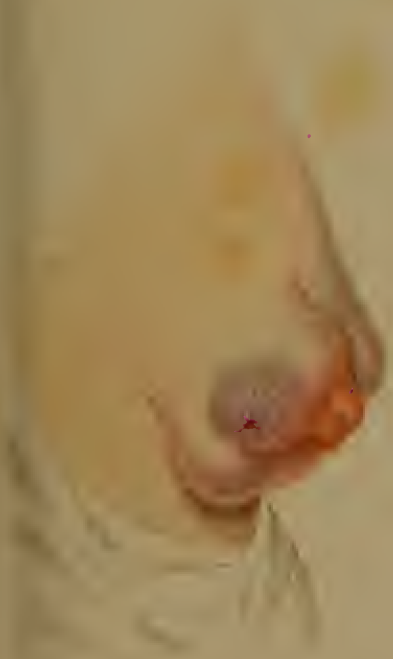

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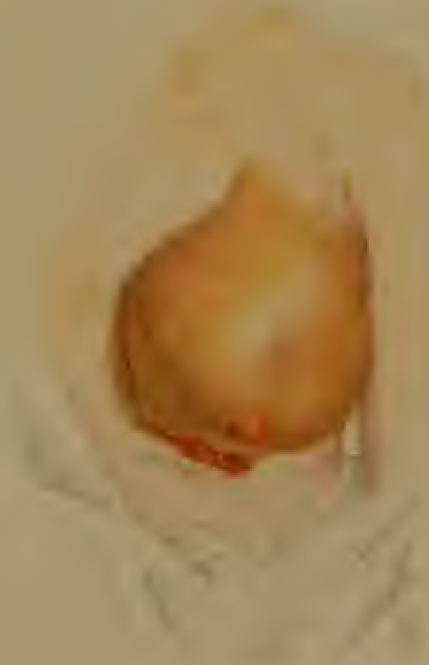


case its progress is much alike. In Plate IV, figs. 1, 2, 3, these changes are clearly shown.

Tuberous cancer.
Characters.
Varieties of terms used.

Tuberous cancer commences as a circumscribed independent growth within the gland structure, with a well-defined capsule separating but not infiltrating the tissues (Fig. 401). Sometimes two or more tubers appear together, and these may at last coalesce. This form, unlike the infiltrating, does not contract, but grows in all directions, involving all the parts which it touches, pushing the breast to one side, or drawing it to itself (Plate IV, fig. 4). It often attains a large size, giving rise to an irregular lobulated tumour. It is at times soft in consistence, when it is called *medullary* cancer; when firm, it is known as *fibrous;* when jelly-like, *gelatiniform;* and more rarely it is black or *melanotic*. As it grows forward it may involve the skin, break and ulcerate, giving rise to the appearances formerly called *fungus hæmatodes*, this form being always accompanied with hæmorrhage (Plate V, fig. 1).

Condition of lymphatic glands.

In both forms, the lymphatic glands in the axilla, above the clavicle, or on the side of the neck, will sooner or later become involved; and, when the skin is implicated, this symptom soon appears. As the glands enlarge, nerve pains down the arm appear, and œdema of the arm commences from the mechanical obstruction to the venous circulation of the extremity caused by the enlarged glands. At times a serous effusion takes place into the pleural cavity of the affected side sufficient to destroy life.

Brawny cancer.

In some rare cases of cancer the disease appears as a *brawny* infiltration of the breast and integument over it, some erythematous redness and œdema being mixed with it at its onset. These cancers are of the worst kind, and speedily destroy life.

Atrophic form of cancer.

In other cases, mostly chronic, the disease is more cutaneous, and shows itself as a tubercular affection of the skin, which gradually spreads till at last the part affected seems skin-bound. This condition may be limited or extensive, and occasionally involves the whole of one side. I have recently had a case under observation in which both breasts, the sternum, sides, and half the dorsal region of the back were thus involved. At times this tubercular development is associated with acute or recurrent disease. In rare examples it occurs as a primary affection, and is very chronic, the tubercles even disappearing by atrophy.

Cancer.

A cancerous tumour of the breast most frequently appears in middle life, that is, when the procreative organs are verging towards their natural period of functional decline, such a period taking place at an earlier date in the single than in the fruitful woman. It attacks married women more frequently than the unmarried, and, when infiltrating or involving the breast-gland, is seldom stationary.

Progress.
Characteristic ulceration.

As the disease progresses unchecked, ulceration of the integument, preceded by a softening down or breaking-up of the tumour itself, will soon appear, and with this the characteristic infiltration of the margin of the wound will occur and give rise to indurated, everted edges (Plate V, fig. 1; and Fig. 405). A general cachexia from the pain and wasting discharges will soon show itself, and more or less distinct evidences of the complication of other organs become apparent. Under such circumstances the end is not far off, for the disease has run its course, and with it the powers of its victim have become undermined, for the victory remains with the strongest. In a general way a cancer runs its course in two or three years; though sometimes it is most chronic in its action.

To illustrate some of the points connected with this subject the following analysis of 400 cases may be of value. The cases are taken from my own notes; 180 occurred in Guy's during the period of my registrarship many years ago, and 220 are from my own case-book since.

Age when disease appeared.

The *disease made its first appearance*—

In	17 cases, or	4 per cent.,	under	30 years of age.
„	108 „	27 „	between	31 and 40 years of age.
„	144 „	36 „	„	41 „ 50 „
„	101 „	25 „	„	51 „ 60 „
„	29 „	7 „	„	61 „ 70 „
„	1 over 70 years of age.			

I have, however, seen a case of cancer of the breast in a patient aged 28, and one of a year's standing in the breast of an old lady æt. 96.

Social condition.

Of these 400 cases, 313 were married, 77 single, and 10 were widows.

Prolific or sterile.

Of the 313 married, 235 were prolific, and 78 sterile. A large proportion of the prolific women were so to an extreme degree, ten and more children being a common note to find recorded. Married women and those in whom the gland has been the most active, are apparently more liable to cancer of the breast when the period of gland activity has passed, than the single.

Side affected.

194 of these examples were in the right breast, 187 in the left, and 19 in both.

Duration of disease.

In 140 the disease had existed a year or less.

In 99 between 1 and 2 years.	In 13 between 4 and 5 years.
„ 23 „ 2 „ 3 „	„ 9 „ 5 „ 7 „
„ 15 „ 3 „ 4 „	„ 6 „ 8 „ 9 „

In four cases, the disease had existed ten, twelve, fourteen and twenty years respectively, and the form of cancer in these of long standing was the atrophic.

Hereditary history.

With respect to any *hereditary history* of cancer in the 400 cases, although carefully inquired into, I found it to exist in only 47 or nearly 12 per cent. In 35 of these, cancer was reported to have occurred in one member; in 11 in two members; and in 1 in three of the patient's family.

In 7 of the 47 cases the relative was on the father's, in 23 on the mother's side, and in 7 it was found among the brothers or sisters. In 5, it had attacked the aunts, in 3, cousins, and in 1 a grandmother, although in these the point was not stated respecting the paternal or maternal relation. These facts are enough to indicate that where an hereditary tendency exists, it is more powerful on the mother's than the father's side.

In a large proportion of the cases in which an hereditary history of cancer was traced, the cancer was of the breast.

A section of an infiltrating cancer is well shown in Fig. 400, but better in Plate VI, Fig. 1. A section of the tuberous form in Fig. 401. For the microscopical appearances of cancer *vide* Fig. 42.

On colloid cancer.

Colloid or alveolar cancer is occasionally seen in the mamma, although in a clinical point of view the growth presents no such features as to enable the Surgeon to recognise its presence. In Fig. 34, page 179, Vol. I, a cancer of the kind is illustrated. In it, the clinical features of the affection were those of the cystic disease. It is found in the gland as an infiltrating and tuberous growth.

Characters.

To the eye, the colloid disease has a peculiar aspect, its jelly-like semi-transparent material of all tints of pink and red from degrees of blood-staining being divided by thin meshes of fibre tissue into cells of different sizes. The way the jelly-like structure oozes from its cells, and the slight changes that take place in it after immersion in spirit, are its chief characteristics.

It ought to be treated by excision of the whole gland.

Cystic Tumour of the Breast.

On cystic tumours.

Simple sero-cyst.

Characters.

The simple sero-cyst is usually found single in the mammary gland, and appears as a small hard lump in one spot which is at times, but not often, painful. As it increases it becomes more globular and dense, sometimes being of a stony hardness; while at a still later date it may afford the sensation of fluctuation. If left alone it may so enlarge as to come forward and even burst, discharging a thin watery *non*-albuminous fluid, and then collapsing. In rare cases, the disease is thus cured; but more commonly the fluid re-accumulates.

"The cyst wall of this tumour," writes Birkett, "is very thin, composed of fibre tissue, firmly attached to the surrounding parts, and lined with squamous epithelium. It is always perfectly closed, and never communicates with a duct."

Treatment.

Such a cyst should be punctured with a trocar and canula, and some cold lotion applied, for by this means many are permanently cured. Brodie employed alone, without puncture, a lotion made up of an ounce of the solution of the subacetate of lead and three ounces and a half of both spirits of wine and camphor, which was to be applied on a piece of folded flannel, and renewed every three or four hours until the skin over the tumour had become inflamed; the application to be re-applied after the lapse of two or three days.

Spurious cyst in other forms of disease of breast.

Besides the simple serous cyst, many examples of tumours of the breast come under the observation of the Surgeon, the diagnosis of which is much obscured by the presence of cysts, or rather of what Mr. Birkett describes as capsules, containing fluid of divers characters. For the development of a cyst in the majority of tumours is a mere accident due to the effusion of fluid, probably serum, more or less blood-stained, into the connective-tissue of the part, the fluid separating the solid growth and so forming an apparent cyst. Such a cyst, however, is not a new development, like the more solid portion of a tumour, nor is it in any way to be compared with the simple cystic formations which are found in the neck or other portions of the body.

Characters.

The existence of the false cysts, therefore, such as I have briefly sketched, in any of the breast tumours, whether adenoid or malignant, is to be regarded as a mere accident, and ought to have no weight in determining either the innocency or malignancy of the growth under

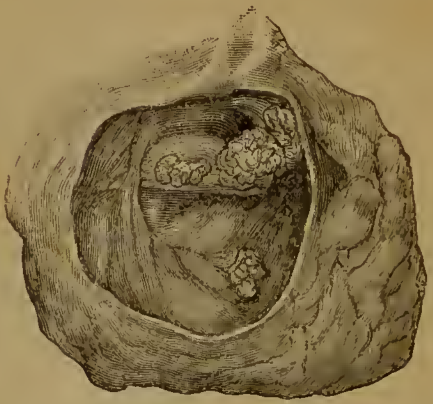
Cysts as a means of diagnosis.

examination; they are the product of a mechanical cause, may occur in either form, are not special growths nor of any intrinsic importance. The diagnosis of the tumour containing such cysts rests consequently on other points, and more particularly on such as have been already indicated. As a rule, these so-called cysts are found in the less firm and solid forms of tumour, in such as contain less cellular or connective tissue, and in the more rapidly developed rather than in the slowly formed. We thus find in *one* form of cystic adenoma a more or less solid tumour, the growth being more lobulated and loosely connected where the false cysts or capsules exist (Plate VI, fig. 2). In a *second* class of cases loose pedunculated growths will be seen lying within these capsules, with their floating extremities bathed with the so-called cyst contents (Fig. 402), the different forms assumed by these

Cystic adenoma.

Pedunculated growths in cysts.

FIG. 402.



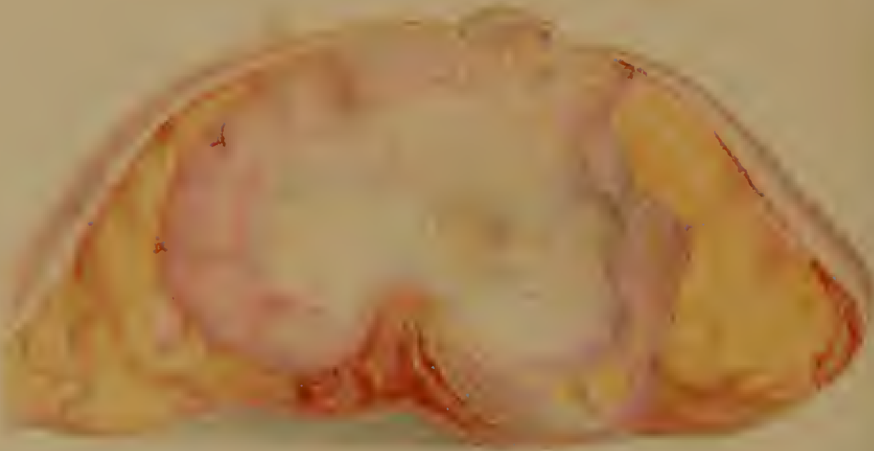
Cystic tumour in breast, with pedunculated adenomatous growth of one year's existence, removed by T. Bryant from S. W, æt. 43, in 1876. Three years later patient was quite well.

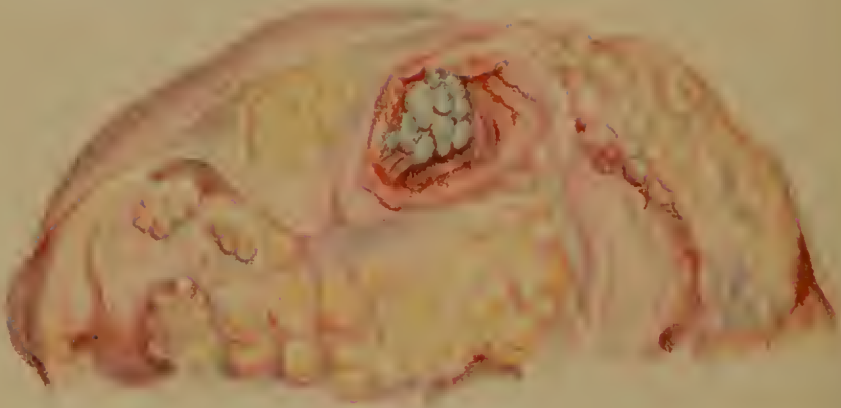
tumours depending upon the amount of connective tissue which binds together the several lobes and lobules, and the dimensions of the interspaces which go to form the false cysts. In a *third* class, however, the *true cystic adenocele* of the breast, the adenoid solid elements are developed within cysts composed of dilated ducts. But in all, whether within false cysts or in dilated ducts, the elementary structure of the growths is either dense and compact, or loose and pedunculated; in all, they simulate the structure of normal gland tissue. In some, the cæcal terminations of the ducts are the most prominent, and in others, the ducts and sinuses, while in a few, true milk or cream secretion exists, precisely similar to that secreted by the breast. In Plate VI, fig. 2, every variety of this affection can be seen. In all probability, all adenomata are developed in cysts as intra-cystic growths. Dr. Goodhart, in an able paper, has supported this view ('Edin. Med. Journ.,' 1872).

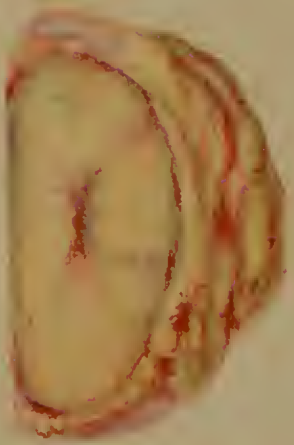
Cysts consisting of dilated ducts.

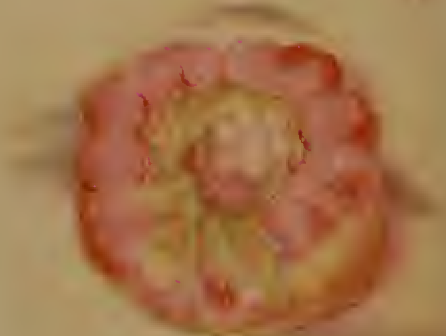
This true cystic adenocele, however, is of an innocent nature and pathologically allied to the genuine adenocele. It is the tumour originally described by Sir B. Brodie as "arising by a dilatation of portions of some of the lactiferous tubes," and by Mr. Birkett as duct-cysts,

Diagnosis of true cystic adenocele.









DESCRIPTION OF PLATE VI.

FIG. 1.—A section of an **Infiltrating Cancer of the Breast.** Also Fig. 400, page 270, and Fig. 401, page 270, section of a **tuberous.**

FIG. 2.—A section of an **Adenoma of the Breast.** Fig. 396, of the more solid kind (fibroma).

FIG. 3.—A section of a **Sarcoma of the Breast.** Also Fig. 404.

FIG. 4.—**Paget's Disease of the Nipple** in its cancerous stage.

distinctly referable to the dilatation of a duct, or to a connection with one, and containing growths which appear to spring from their walls, and these two forms of cystic adenocele are strictly analogous in their nature. In both, the pedunculated or floating bodies possess a structure allied to the breast-gland, and are composed of more or less distinct cæcal terminations of newly-developed ducts, with variable quantities of true connective tissue. This affection is more common in middle than in young life. Out of 12 cases, 6 occurred in women under 30, 17 in women over 40, while 1 was as old as 71 ('Path. Trans.,' vol. xvii, p. 283).

Diagnosis of cystic adenoma.

Diagnosis.—How, then, is such a tumour to be made out? and what are the special symptoms which characterise it from the other forms of mammary tumour?

Is an innocent growth.

First of all, being an innocent tumour, it will be found to affect the patient in a purely local manner, as all other adenoid tumours do. It is a local disease, which at no period of its growth and in no way will affect the patient otherwise than through local causes. It is never associated with secondary glandular enlargements or with deposits in other tissues, as the cancerous tumour, and it can, therefore, be by local symptoms only that a correct diagnosis is to be made.

Made up of cysts.

A disease of the gland itself.

The tumour, being a *genuine cystic disease*, is always made up of cysts filled with intra-cystic growths in different degrees, and *it is also a disease of the gland itself*, the cysts having a distinct relation with the gland ducts. The cysts having, therefore, in the majority, if not in all cases, some communication through the nipple with the external surface, can be partially emptied of their contents by pressure through the nipple of the affected organ. As a result, this discharge from the nipple must always materially tend to confirm the impressions which may have been formed by the careful observation of the case, and by the presence of those conditions to which attention has just been drawn.

Summary.

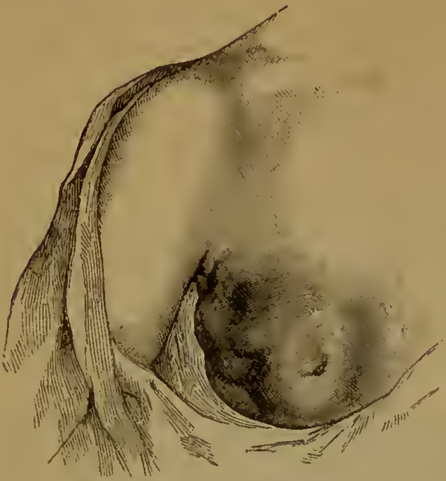
Consequently *a cystic tumour of the mammary gland* in a healthy woman, unattended by any other than local symptoms, and associated with the discharge of a clear or coloured viscid secretion from the nipple, which can be induced or materially increased by pressure, may, with considerable confidence, be set down as the *true cystic adenocele* of the breast. The false adenoceles or other tumours, which have but little if any connection with the true gland tissue, are new growths partaking of the nature of the breast-gland, according to the universal pathological law, that all new growths partake of the nature and peculiarities of the structure in which they are developed. In Plate V, Fig. 4, the external appearances of one of these cystic adenoceles are well seen; also in Fig. 397.

Galactocele.

Galactocele.

This is a milk tumour found in the breast during lactation, the result of some retention of milk in an obstructed or ruptured duct, the secretion being either fluid milk-like, or more solid and creamy, owing to the absorption of the more fluid elements. Prep. 2290^{50}, 2290^{80}, and 2299^{40}, Guy's Museum, illustrate these points. It usually occurs somewhat suddenly during suckling, and is indicated by a painless fluctuating swelling, unaccompanied by any constitutional disturbance. These cysts at times attain a large size. Scarpa has recorded a case in which two pints of milk were removed from the tumour. It should be treated by an incision into the cyst, leaving the walls of the cavity to granulate.

Fig. 403.



Cystic carcinoma of breast of nine months' growth taken from S. P., æt. 56. Skin over breast involved, nipple drawn in, axillary glands enlarged. Three months after operation there was a large axillary growth and œdema of arm. Mr. Birkett's case. Drawing 408¹².

Cystic Cancer.

Cysts in cancer.

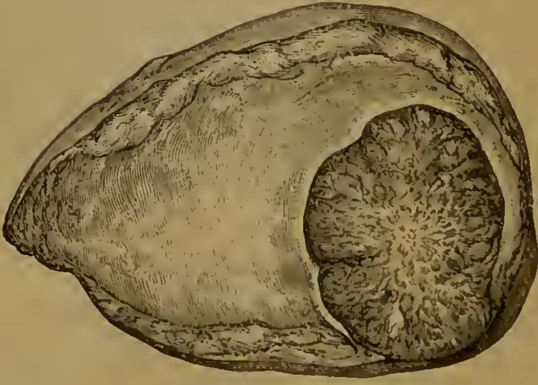
The pathology of cystic cancer is identical with that of cystic adenoma, while the cysts in the one instance contain the more or less solid characteristic lobules of the adenoid growth, and in the other are filled with the less developed and more irregular, but equally characteristic material which goes to build up the cancerous tumour. The diagnosis of these cancers rests, therefore, upon such points as have been already described under a former heading (Fig. 403).

Sarcomatous Tumours of the Breast.

Sarcomatous tumours.

Sarcomatous tumours of the breast are met with in women of middle age, and they are generally more succulent and less solid (*vide* Plate VI, Fig. 3) than the adenomata and more rapid in their growth, while they have also a greater tendency to return after removal. They are more closely connected with the breast than the

Fig. 404.



Sarcomatous tumour of nine months' growth, removed from M. T., æt. 33, by T. Bryant in 1877. Good recovery.

adenomata, and are always encapsuled (Fig. 404); they do not infiltrate the breast like the cancers. They run their course moreover more rapidly than the former, and have a tendency to break down, and give rise to a bleeding mass of tissue which may be mistaken for a cancer. They are also local, and are rarely associated with any secondary glandular enlargement. They should be dealt with as adenomata and removed, and the breast, as a rule, should be removed with them. I have the records of many interesting examples of this form of tumour, and in the 'Path. Trans.' for 1868, vol. xix, I recorded the case of a woman, æt. 35, from whom I removed a tumour weighing nearly five pounds. The patient from whom Fig. 404 was taken was thirty-three years of age, and in her no return took place after operation, a result which is not constant, since in a large number of these cases the disease returns locally, and acts in that point as badly as any cancer. I have a patient now under care from whose breast I have removed five tumours at different intervals. When a return takes place the tumour should be excised at once, if the measure be practicable.

On hydatid cysts.

Hydatid cysts are found in the breasts, but are not common. Only one example has fallen into my hands, although I have seen five others in the practice of my colleagues. My own patient was a woman, æt. 30, who for five years had had a *painless globular swelling* in her left breast, and when I saw her it was as large as a cocoa-nut. I tapped the cyst and evacuated sixteen ounces of a clear non-albuminous fluid, and, as it was evidently the fluid of a hydatid, I made a free incision into the tumour and turned out a large acephalocyst. The patient made a good recovery.

Nævus of the breast.

Nævus, involving the whole mammary gland, may be met with. I have had under my care a splendid example in a girl, six years old, in which the whole organ was like a sponge and as large as half an orange.

Open cancerous ulcer.

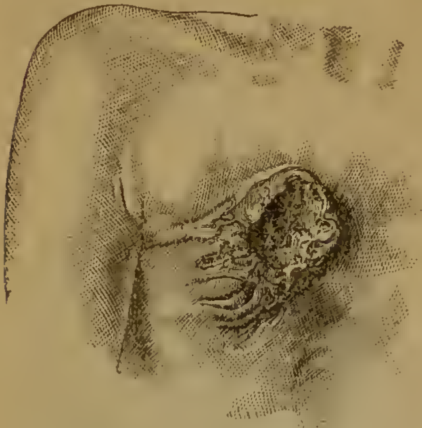
On the Open, Ulcerating, and Discharging Tumour of the Breast.— In the growth of any tumour situated in the mammary gland or its neighbourhood there must be a period when the integuments will become so involved as to ulcerate or give way, and, under these circumstances, a discharging surface or cavity will present itself, varying in its aspect according to the innocency or malignancy of the growth with which it is associated. If the tumour is *cancerous* the open surface or discharging orifice will suggest its nature, and the integument itself or the margins of the wound will be infiltrated with cancerous material, the latter presenting the thickened, indurated, and everted margin so characteristic of the cancerous ulcer, and which, when once seen and appreciated, can hardly be mistaken (Fig. 405). But if the tumour be *innocent*, a very different condition will present itself, for a clear understanding of which it is essential to recall one or two points of difference between the innocent and malignant tumours, although attention may previously have been drawn to them in former pages. It is the peculiar nature of the innocent tumour to affect the part in which it is developed simply in a mechanical way; it may separate or displace, but never infiltrates tissues. On the other hand, it is the peculiar nature of the cancerous or malignant to infiltrate and involve every tissue with which it comes in contact. Applying, therefore, these two opposite features of the innocent and malignant tumours to the class of cases now under consideration, we shall readily understand how two very different local appearances may be produced, and how in

Summary of the two distinct characters.

the cystic cancerous disease the wound or surface will be characterised by all the peculiarities of the cancerous ulcer, and in the cystic innocent tumour which may have ruptured from over-distension, the margin of the wound or discharging cavity will look healthy, free from all appearance of infiltration, and rather as if mechanically cut or punched out than ulcerated. In the *cystic adenoceles*, in which it is not uncommon to find a sprouting and discharging intra-cystic growth protruding from a wound through the ruptured integument, and presenting a very doubtful and sometimes cancerous aspect, the importance of this symptom cannot be overrated, for if found projecting through an orifice of the integument which is uninfiltrated and apparently healthy, such as we have already described, the innocent nature of the tumour may with some confidence be declared (Plate V, fig. 4).

Cystic adenoma.

FIG. 405.



Open cancer of breast, with infiltration of skin. Model, Guy's Mus.

On the Value of the Retracted Nipple as a Symptom in Tumours of the Breast.

Retracted nipple as a symptom.

Retracted nipple an accidental symptom.

There can be little doubt that, as a positive indication of cancerous disease, the importance of a retracted nipple has been considerably overrated. The symptom may be common in infiltrating cancer of the breast, but such a disease may exist without it; it may be present, moreover, in simple non-cancerous affections. A retracted nipple may be regarded as an accidental symptom in the development of a tumour, as well as the product of mechanical causes, its presence being determined rather by the manner in which the gland is involved than by the nature of the disease. If any tumour, simple or malignant—any abscess, chronic or acute—attack the centre of the mammary gland a retracted nipple in all probability will be produced; for a disease so placed necessarily causes separation of the gland-ducts, and, as a consequence, their extremities, terminating in the nipple, will be drawn upon, and a retracted nipple must follow. We thus find this symptom of frequent occurrence in the early stage of an infiltrating cancer of the organ, the nipple being always drawn towards the side of the gland which may be involved; while at a later stage, when the infiltration is more complete, the nipple may again project. In a central chronic abscess of the breast the retracted nipple is equally common, and in the true cystic adenocele it may be also present. In the ordinary adenocele, whether cystic or otherwise, it is rarely met with, for the reason that this disease is not of the breast-gland itself, but only situated in its neighbourhood. In rare cases, however, such an association may co-exist, and in one case in which I observed it some blow or injury had preceded the development of the adenoid tumour, and it was open to a doubt whether the retracted nipple had not been brought about by a chronic inflammatory condition. It should always be remembered, moreover, that a contracted nipple may be a natural condition.

On the discharge from nipple.

On the Value of a Discharge from the Nipple for Diagnostic Purposes.—When the discharge is slight or of a bloody nature, it does not indicate any special affection, though it is well known that in *cancerous* affections a discharge from the nipple is not unfrequent, the fluid having the appearance of blood-coloured serum, which is never profuse, and rarely amounts to more than a few drops. In the *true cystic adenoceles*, this symptom is of considarable value, for in all the cases which have passed under my observation, as well as in the majority of recorded examples, this discharge from the nipple was a prominent symptom, the fluid being generally of a mucoid nature, and more or less blood-stained; and although at times it occurred spontaneously, and with relief to the patient, at others it could readily be induced by some slight pressure upon the parts. In the *ordinary adenoceles* this symptom is seldom present. It exists therefore as a symptom in the true disease of the breast structure, whether cancerous or adenoid; and while slight and uncertain in the former, it is more general and copious in the latter; consequently, as a means of diagnosis, it is of some value.

In cancer.

In cystic adenocele.

In adenocele.

On Chronic Disease of the Mammary Areola preceding Cancer.
(Paget's disease.)

On disease of mammary areola in cancer.

Sir J. Paget has pointed out ('St. Bartholomew's Hosp. Rep.,' vol. x, 1874), what my own experience confirms, that cancer of the breast is sometimes preceded by a chronic skin disease of the nipple and areola; the disease in the majority of the fifteen cases in which he had observed it having "the appearance of a florid, intensely red, raw surface, very finely granular, as if nearly the whole thickness of the epidermis were removed; like the surface of very acute diffused eczema, or like that of an acute balanitis. From such a surface there was always copious, clear, yellowish, viscid exudation" (Plate VI, fig. 4). In some cases the eruption has presented the characters of an ordinary chronic eczema or psoriasis, the eruption spreading beyond the areola in widening circles, or with scattered blotches of redness covering nearly the whole breast.

"The eruption has resisted all treatment, both local and general, and has continued even after the affected part of the skin has been involved in the cancerous disease."

Micro-scopical appearances.

Mr. Henry Butlin has shown that these changes are due to an extension of the disease from the surface of the nipple to the smaller ducts and acini of the gland, these parts being found filled on microscopical examination with proliferating epithelium, which at times escapes from the ducts by rupture or growth into the surrounding tissues, thereby producing the full formation of carcinoma ('Med.-Chir. Trans.,' January, 1877), the mechanical retention of the epithelial element, within the gland and ducts evidently playing an important part in the progress of this disease. Whether the disease be a true eczema or a specific dermatitis, questions which have to be determined, the conclusion is clear that the local disease is not to be disregarded. When much epidermis collects upon the nipples "Busch's practice in cases of epithelioma ought to be followed, and such should be removed by the application of a lotion of soda, from 3 to 6 grains to an ounce," and if any suspicious hardness of the base of the sore exists it should be removed.

On the Importance of Enlargement of the Absorbent Glands as a Diagnostic Symptom.

On enlarged glands as a symptom.

When some enlargement of the axillary or clavicular glands exists with a chronic tumour of the breast the malignant nature of the disease is rendered probable; for the simple adenomata are generally unattended by such a complication, and with the cystic affections it is also rare. Many months, however, may elapse in cases of cancer of the breast before the appearance of this symptom, because enlargement of the absorbent glands and infiltration of the skin have some connection.

In cancerous affections the enlargement of the glands is indolent and very painless. In the inflammatory affections of the organ, glandular enlargement and tenderness are commonly present.

On the Value of the Tubercular and General Infiltration of the Integument over the Breast.

On tubercular and general infiltration as a symptom.

When the integument of a breast is sparsely or thickly studded with shot or pea-like tubercular infiltrations, or is so infiltrated with new material as to present a brawn-like feel and aspect, there can be no question as to the cancerous nature of the disease, since such a symptom is never present in any inflammatory or simple disease of the mammary gland. The infiltration may be slight, from the mere shot- or pea-like affection of the skin, to its more brawny infiltration; but in all stages it is equally characteristic, and speaks in positive language of the cancerous nature of the mammary growth, one tubercle telling as plain a tale as if many tubercles existed.

Cachexia as a symptom.

Cachexia.—I have no belief in the existence of a special cancerous cachexia. A cachexia may be present in cancer as in any exhausting or wasting disease; but that of cancer differs in no single point from that of any other affection. When a cachexia exists, it indicates the presence of some affection which is undermining the patient's strength, which may be cancer, but it may be any other form of disease.

On Excision of the Breast.

On excision of the breast.

There is no great danger attending excision of the breast beyond that which accompanies any, even the smallest, operation. It is true that patients occasionally sink after the operation from pyæmia, erysipelas, or visceral diseases, but these contingencies attend any operation or wound.

Mortality in excision.

From my notes of 133 cases of cancer in which excision was carried out I find that nine died, or about 6·7 per cent., while in four only, or 3 per cent., could the death be ascribed to the operation.

Causes of death.

One died from pyæmia, on the thirty-fifth day; one from erysipelas, contracted several months after the operation, when the wound had healed; two from acute bronchitis, three weeks and a month respectively after the excision; one from profuse diarrhœa, on the eighth day, probably pyæmic; one from hæmoptysis in the third week; two from exhaustion after a return of the growth, in three and six months; and one from actual sinking after the operation on the third day. The three cases which died from pyæmia and diarrhœa, which was also probably pyæmic, and the one which sank on the third day may, perhaps with justice, be directly assigned to the operation, but the fatal termination in the remaining five examples had no reference whatever to the excision. In the operations for innocent tumours of the breast no fatal instance occurred.

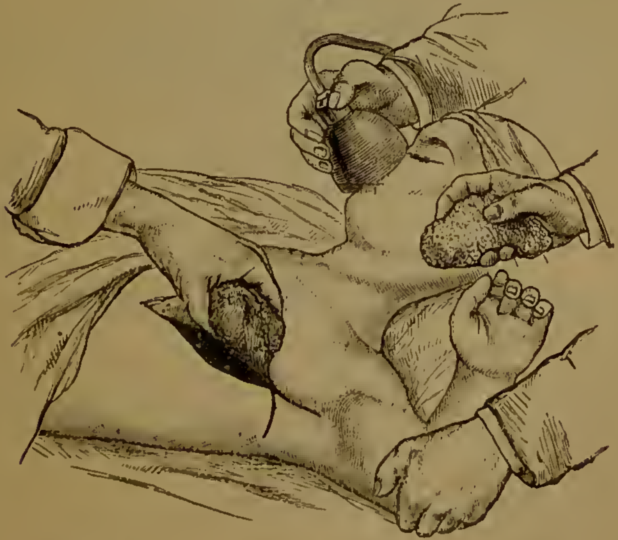
In cancer the whole breast to be removed.

In operating for cancer it is unquestionably the wisest course to excise the whole gland. It is well not to be over-anxious about preserving too much integument, and if any doubt exists as to its perfect healthiness the suspected portion had better be excised. When enlarged glands exist they should be taken away, and in any doubtful case the axilla should be explored. It is always important, when dissecting out the tumour to keep clear of all diseased tissues, and, in fat subjects, to leave a fair covering between the incision and the tumour itself, as there is good reason to believe that an early return of the affection is too often to be explained by want of attention to these points. In several instances I have found small cancerous nodules in the fascia over the pectoral muscle, which if left would have been the centre of new growths. In the operation for *adenocele* it is quite exceptional for the removal of the breast to be necessary. In the majority of instances such a practice would be clearly unjustifiable. As a rule, the tumour is readily removed by making a clean section through its cyst-wall and enucleating the growth; the breast is rarely injured, even by the operation. In exceptional examples of this affection, however, that is, where a large tumour is closely connected with the mammary gland, as well as in the genuine or true cystic adenocele, it is absolutely necessary that the breast-gland should be excised. In the removal of a small tumour, not involving the breast, the best practice

In adenocele it is not necessary.

Mode of operating in such cases.

Fig. 406.



Excision of the breast, with incision backwards for drainage.

is to make the incision in a line radiating from the nipple, and to manipulate the parts as little as possible; the surest plan being to cut well into the tumour after having raised and made it prominent by grasping its base with the thumb and finger of the opposite hand.

Description of the operation for excising the breast.

The Operation.—In the removal of a breast the patient should be placed on her back with the shoulder of the affected side raised by a pillow, and the arm drawn out at a right angle to the body (Fig. 406).

The incision should be elliptical, and made in a line parallel with the fibres of the pectoral muscle, and when the skin is diseased it should be removed. The inner or sternal incision should first be made, and bleeding is to be controlled by the pressure of the fingers of an assistant. The second or pectoral incision may then follow, and should be made down to the free border of the pectoral muscle, the definite form of which is the best and surest guide to the base of the gland. The whole tumour by these means is thus readily excised, a few touches of the scalpel dissecting it off the pectoral muscle. The axillary angle of the tumour should be divided last, as it usually contains the chief vessels that supply the gland. The incision can be extended upwards into the axilla to explore or remove the glands. When this is done an incision at right angles to the wound backwards is good for drainage purposes. All bleeding vessels should be twisted, the surface of the wound cleaned with iodine water, its edges well adjusted, a drainage tube introduced at the most dependent part, and steady pressure applied by means of pads of lint, gauze, or cotton wool. *Adenoid* or innocent tumours should be excised only if they are steadily increasing, and are sources of trouble. *Cancerous* tumours should be removed as soon as the diagnosis of their existence is clear, for accumulated evidence tends to show that the earlier a cancer is removed the better are the prospects of a complete or lengthened immunity from the disease, and that, whether the disease returns soon or late, the best chance is thus afforded to the patient.

CHAPTER XXVII.

ON OVARIAN DISEASE AND OVARIOTOMY.

The ovaries are glands, and are developed as other glands, being composed of like elements. In them, during infancy and childhood, although cell growth and even cell shedding may go on, such processes take place silently, unattended by any external manifestations of their action. At puberty, however, when the ovum has matured and impregnation becomes possible, external signs of these changes appear with menstruation, and with these changes functional disturbances of the ovaries and parts connected with them occur, and may require the attention of the physician. The Surgeon's aid is only called for when organic ovarian disease exists, and the nature of this aid varies with the nature of the case.

Ovarian disease.

Ovarian disease is a somewhat common affection, and, although mostly met with during the active period of ovarian life, it occurs in childhood and mature age. Two specimens now in the College of Surgeons were taken from twin children five and eight weeks respectively by Dr. Leared, and a rare preparation at Prague shows a cyst in the ovary of a child a year old. Roemer, of Berlin, in 1884, records a case in which he successfully removed a dermoid ovarian tumour from an infant twenty months old ('Brit. Med. Journ.,' April 12, 1884). Kidd, of Dublin, has operated on a child aged three. Spencer Wells has recorded a successful case of ovariotomy in a child aged eight. Dr. Barker, of Philadelphia, had another in one aged six years and eight months. I have recorded two cases in which girls, aged respectively fifteen and sixteen, sank after tapping from suppuration of the cyst; and in 1869 I published in the 'Guy's Hospital Reports' a case in which I successfully removed a polycystic ovarian tumour from a child aged fourteen, in whom no signs of puberty existed. But these instances are exceptional, and ovarian disease is essentially an affection of mature adult life. In Spencer Wells's 1000 cases the age averaged thirty-nine.

Ovarian tumours may be clinically divided into four classes:—*Monocystic,* or unilocular tumours; *polycystic,* or multilocular tumours; *dermoid* cysts; *fibrous* and *cancerous tumours.* The relative frequency of these different forms of tumours is well seen in the following conclusions which were drawn up after a careful examination of the records of 88 fatal cases of ovarian disease, extracted for me by the late Dr. Phillips from the Guy's Records, and copied from my work 'On Ovariotomy' published in 1867.

Analysis of eighty-eight fatal cases and conclusions derived therefrom.

Conclusions, *drawn from an analysis of* 88 *fatal cases of ovarian disease :—*

1. That 9 per cent. of the ovarian tumours are apparently monocystic; 9 per cent. dermoid; 18 per cent. cancerous; and the remaining 64 per cent. polycystic or more or less solid.

2. That 53 per cent. of the cases are on the left side, 20 per cent. on the right, and 17 per cent. double.

3. That simple cystic disease of the ovary is rarely double, and that, when double ovarian disease exists, the majority of the cases are cancerous, colloid, or of the solid kind.

4. That about 70 per cent. of the cases are in married women, and that the disease is most frequent between the age of twenty and forty, or during the vigour of sexual life.

5. That the disease runs its course in at least 75 per cent. of all cases within two years; 30 per cent. dying from exhaustion, 20 per cent. from peritonitis, 17 per cent. from suppuration of the cyst chiefly following tapping, 9 per cent. from the last two causes combined, 10 per cent. from peritonitis caused by rupture of the cyst, 10 per cent. from the cyst ulcerating into some viscus, such as the intestine or bladder. Hæmorrhage into the abdomen and strangulation of the bowels by the pedicle caused death in one case.

6. That in the *monocystic* tumours there is a greater disposition for the cyst to ulcerate into the bowels than in other cases, and to suppurate after tapping.

7. That in 56 per cent. of the cases of cancerous disease both organs are involved.

8. That in the dermoid tumours there is a greater disposition for the

cyst to rupture than in all other forms of disease, death being directly due to this cause in 37 per cent.

9. That acute peritonitis and suppuration of the cyst as a direct result of the operation of tapping is by no means unfrequent.

Spontaneous recovery.

Rupture of cyst.

Cases of *spontaneous recovery* occur, but they are so rare that they must not be looked for. When they occur they take place by rupture of the cyst, and this rupture is generally the result of accident or violent muscular action. As a rule, however, when a cyst ruptures, death takes place from shock, peritonitis, or blood poisoning (*vide* conclusion 5). In exceptional cases, when the cyst has discharged itself into the large intestine, the event may be signified by a copious discharge of the cyst's contents by the rectum; but when into the small bowel no such event may occur, the fluid being reabsorbed. Under both circumstances, there is always great danger to life from the entrance into the cyst itself of fæcal matter or fetid air.

Diagnosis of an Ovarian Tumour.

Diagnosis of ovarian tumour.

When an ovarian tumour has attained a considerable size, has risen well out of the pelvis, and is unassociated with any complications, its diagnosis, as a rule, is not difficult, more particularly if it can be made out to be composed of many cysts, *i. e.* multilocular. But when the tumour is small or very large; unilocular or very solid; central or of rapid growth, difficulties of diagnosis are met with, and it may be admitted at once that under any of these circumstances there are few surgical cases that demand more care on the part of the Surgeon before he gives an opinion, and still more caution before he acts upon it. In some few instances, indeed, a positive diagnosis cannot be made without the help of some exploratory operative proceeding. Under all circumstances, however, "in the diagnosis of a suspected ovarian case every possibility of its nature should be entertained, and a conclusion arrived at by a process of exclusion; each possibility should be separately considered and weighed, and the most probable finally accepted."

The possibility of a solid or semi-solid tumour being due to pregnancy, and the probability of a cystic tumour being complicated with pregnancy or hydramnion, ought always to be before the mind of the Surgeon; while the complete cessation of the menses for a few months in connection with the existence of an abdominal tumour, ought also to suggest in diagnosis caution and delay, when for diagnostic or curative ends operative measures are being considered, since though catamenial irregularity is common in ovarian disease, total arrest for any time is rare.

Diagnosis of ovarian tumour.

The early history of an ovarian case is always obscure, and the statements of patients concerning its early growth must be accepted with caution. In a general way the tumour is discovered by accident, or attention is first drawn to its presence by abdominal enlargement.

Pain is rarely present in the early stage of the disease, and when it exists is usually the result of mechanical causes; that is, it is due to the impaction of a small ovarian tumour in the pelvis, or to the pressure of a larger one upon the viscera, vessels, or nerves.

When the tumour presses upon the bladder, incontinence of urine or dysuria will occur; but when it irritates the bowels, diarrhœa will be caused. When it drags upon the omentum or presses upon the stomach, nausea and vomiting may be present, and where it encroaches upon the thorax, dyspnœa. Nerve pains will be produced, according to the nerves that are pressed upon, and œdema of the genitals, legs, or abdomen, according to the amount of interference to the return of venous blood is commonly caused by the tumour. Œdema of the abdominal walls is said to be typical of cancerous disease of the ovaries, but this is not the case, since I have seen this symptom very frequently in undoubted examples of simple ovarian disease.

Local pain, pyrexia, with a high temperature and abdominal tenderness, associated with a cystic abdominal tumour, generally indicate inflammatory changes within an ovarian cyst.

Dermoid tumours are said to be more commonly and unilocular cysts least frequently attended with pain than any other.

Ovarian expression.

In well-marked examples of ovarian disease the face becomes pinched and the peculiar "ovarian expression" manifests itself, but after the removal of the tumour by ovariotomy it is remarkable how soon this expression disappears.

Differential diagnosis.

The *differential diagnosis* of an ovarian tumour will now occupy our attention, and its physical signs will be first considered as made out by percussion and palpation, since it is by these more than any others that the Surgeon is generally led to an approximate opinion of the nature of the case. Too much confidence, however, must not be placed on them, since they are only of value when taken in connection with other symptoms.

Inspection.

In all cases of suspected ovarian disease the patient to be examined should be undressed, and then placed on her back, with her shoulders and knees raised. The Surgeon should afterwards so expose the abdomen as to be able to have a good look at it, and observe whether the abdominal enlargement is central or lateral, smooth, irregular, or nodular in outline. Should the tumour move upwards and downwards during the respiratory act the tumour is probably free and non-adherent. The Surgeon should then place his hand flat upon the abdomen, and having rested it there for a minute or so to test the points just alluded to, should move it steadily over the whole surface of the tumour in all directions, and at the same time, by palpation, ascertain something of the condition of the deeper parts.

Palpation.

By these means much will have been ascertained as to the nature of the case. It will have been made out whether a tumour exists or not; something will have been learnt, too, concerning its size and mobility, and whether it is solid, fluid, or the two combined. Possibly by some sudden movement of the contents the question of pregnancy may be raised or settled.

Percussion.

The Surgeon should then proceed to percuss the parts, doing this at first superficially, and then deeply. He should also examine for fluctuation, asking himself during the whole examination the following questions:—Is this abdominal enlargement due to tympanitis or is it some phantom—that is, muscular—tumour? Is it due to or complicated with pregnancy, or is it uterine or ovarian disease? Can it be a hydatid, pancreatic ('Lancet,' Feb. 11, 1882), or renal cyst, or an enlarged viscus, such as spleen or kidney? Is it a cancerous tumour?

Possibilities of case.

A fluctuating tumour rising from the pelvis in a central position yielding a dull note on superficial as well as on deep percussion, with epigastric and lumbar resonance, is probably a cystic ovarian growth;

and when the tumour fluctuates in all directions, as is proved by the peculiar thrill of the wave elicited on percussion, the growth is probably *unilocular* or monocystic. When the tumour has an irregular or botryoidal outline, and fluctuation is confined to parts, it is certainly *compound*, the degrees of solidity in a compound or multilocular tumour varying greatly. If the tumour seem to be a unilocular or monocystic growth, the Surgeon must remember that ovarian tumours of this kind are comparatively rare, and that those which appear to be such often contain some intracystic growths. He should also know that purely unilocular cysts are probably broad ligament or parovarian cysts, that is, a cystic degeneration of the tubules of the Wolffian body, although multilocular parovarian tumours have been recorded.

If the tumour be clearly cystic and multilocular, the probabilities are that it is ovarian, and if more solid than cystic it will probably be dermoid or uterine,

Value of resonance.

Uterine and ovarian tumours yield a dull note on deep percussion, and as in these cases the intestines are pushed upwards and towards the loins, these regions are consequently resonant, and no alteration in the position of the patient will alter this fact. In ascites, with the shoulders of the patient raised, the lower portion of the abdomen may likewise yield a dull sound, but with the shoulders depressed and the hips raised, resonance will be made out, the bowels naturally floating on the surface of the ascitic liquid. In ascites, the central portion of the abdomen is resonant and the sides are dull, whereas in ovarian dropsy it is the reverse. "In ascites the greatest circular measurement is at the level of the umbilicus; in ovarian dropsy it is often some inches lower down" (Wells). When the intestines are matted together from cancerous or old peritoneal disease, difficulties occur, and errors in diagnosis can only be avoided by going carefully into the clinical history of the case, and by a pelvic examination. In ovarian disease a friction sound may be detected at times on auscultation or on the application of the hand, while in ascites no such symptom will be present.

On the Diagnostic Value of a Pelvic Examination in Ovarian Disease.

Pelvic examination.

The diagnosis of an ovarian tumour can hardly ever be said to be complete until a pelvic examination by means of the finger and uterine sound and the combined examination between the abdominal wall and rectum have been made, for which purpose the patient had better be placed on her side.

When the uterus is found to be in front of and distinct from the abdominal tumour, and movable without it, the growth is probably ovarian. When the tumour and uterus move together, or, if the uterus be drawn up out of the pelvis, difficulties in diagnosis may be experienced. If the tumour be cystic, it may be ovarian with a short pedicle, a broad ligament or parovarian cyst, or, a cystic disease of the uterus.

When it is solid it may still be ovarian, dermoid, fibrous, or cancerous; or it may be a fibrous tumour of the uterus.

A fixed pelvic tumour is probably neither ovarian nor uterine, but if either, it is cancerous.

In an ovarian tumour, the uterine sound will rarely go beyond two inches, unless complicated with pregnancy or some uterine disease. In cystic disease of the uterus it may enter for six or more.

Caution in using sound.

The uterine sound should not be used too hastily for diagnostic purposes, because when pregnancy and ovarian disease are combined evil may follow its use, although it ought always to be employed before operative measures are resorted to.

When ascites is present, a pelvic examination will generally detect a vaginal rectocele, that is, a bulging into the vagina of the posterior wall of the vaginal passage from the pressure of the ascitic fluid into Douglas's pouch, and this bulging is not met with in uncomplicated ovarian disease, though it may occur when ovarian disease and ascites co-exist. I have found this point of great diagnostic value for many years, and was pleased to read that Dr. Peaslee had mentioned it as one of value.

"Solid uterine tumours," writes Tait, "besides the absence of fluctuation, have in addition two vascular signs which I have never met with in ovarian tumours, viz. an aortic impulse which may be seen and felt, and an enlargement of the uterine arteries to be felt in the vagina."

In pregnancy, there is also to be seen the peculiar purple livid condition of vagina which does not exist in other pelvic tumours, the changed appearance of the nipple, enlargement of the breasts, &c., &c.

I have often found the value of rectal digital examination for diagnostic purposes to be great, and particularly in young or old virgins; but I cannot speak from personal experience of the value of the introduction of the hand. Professor Simon, of Heidelberg, however, speaks highly of it.

On the Value of Tapping for Diagnostic Purposes.

Diagnostic value of tapping.

When there is any doubt as to the true nature of a cystic abdominal tumour, a preliminary tapping ought to be performed, and the physical nature of the fluid examined, although an ovarian fluid in our present state of knowledge is not to be recognised by any definite physical or chemical characters. Drs. Washington Atlee and Peaslee, however, inform us that the fluid of an ovarian cyst may be distinguished from all fluids by the presence of a peculiar cell which they call the ovarian granule-cell, which is about the size of a pus-cell, round and full of granules, and Mr. Thornton has recently confirmed these observations ('Path. Soc.,' March 16th, 1875); adding, moreover, that large pear-shaped, round, or oval cells, containing a granular material with one or several large clear nuclei, with nucleoli and a number of transparent globules or vacuoles are characteristic of malignant tumours.

Ovarian cells.

Of fluid.

When, from what appears to be a monocyst, the fluid drawn is clear, slightly opalescent, and limpid, of a low specific gravity, about 1005, and non-coagulable by heat or nitric acid, or if coagulable by heat the coagulum is re-dissolved upon the addition of boiling acetic acid, there is a strong reason to suspect that the tumour is a broad ligament or parovarian cyst, and, under such circumstances, there is good reason to hope that either a cure may follow the operation of paracentesis, or if not a cure, the lapse of a long interval of time before the repetition of the operation is called for. This fact was pointed out by the late Dr. F. Bird ('Med. Times,' July 19, 1851).

When the fluid drawn off is clearly albuminous, tenacious, dark, or light coloured; when it is even watery and like that contained in the cysts last described, and is found microscopically to contain the compound cells or epithelial elements already referred to, the tumour is probably ovarian, and ought to be removed.

When the fluid drawn off is highly albuminous and coagulates spontaneously, the suspicion of the tumour being a fibro-cystic uterine one ought to be raised, though there is little doubt that the true diagnosis of a fibro-cystic uterine tumour from a polycystic ovarian can only be made out, in the majority of cases, by an exploratory incision, when the absence of the pearly appearance of the ovarian and the presence of the pinkish, vascular, and fleshy aspect of the fibro-cystic, is enough to excite the surgeon's suspicion of the uterine nature of the growth.

Pregnancy and ovarian disease.

When pregnancy and well-developed ovarian disease co-exist, tapping ought to be performed, though in cases where the operation is inadmissible, from the nature of the tumour, ovariotomy is a justifiable proceeding, Spencer Wells and other Surgeons having performed the operation in many cases during pregnancy, and with success; it should, however, be undertaken before the fourth month. When the tumour is small it should be left alone.

Treatment of ovarian disease.

THE TREATMENT OF OVARIAN DISEASE.—In the treatment of ovarian disease medicine is of little value, and has no direct influence in arresting its progress. It does good only by improving the general condition of the patient. The operation of tapping in unilocular cysts is, however, often of great value, and at times essential. Injection of the cyst is only applicable to a small class of cases. Ovariotomy, in a general way, is the only radical cure.

John Hunter's opinion.

John Hunter clearly realised the truth of this in 1787, when he said, "In the early stage of ovarian dropsy I would almost advise that they should be *removed entirely*, if the complaint can clearly be ascertained, as they otherwise will certainly kill the patient." He adds, however, that "*electricity* has been serviceable lately in diminishing the progress of the formation of the fluid in a patient I am acquainted with. How far it will be of further service I cannot say" (MS. lectures).

Ovariotomy a recognised operation.

At the present day the operation of ovariotomy is an accepted one by the profession, and is as recognised and justifiable as any other grave operation. Surgeons and physicians differ only as to the class of cases in which it is applicable and the period at which it should be performed.

British Surgeons may probably claim the credit of having established this operation in spite of early difficulties and blind opposition, and the names of Lizars, of Edinburgh; MacDowell, of Kentucky; Jeaffreson, of Framlingham; Walne; Fred. Bird; Lane; Morgan; Aston Key; Cooper; and Cæsar Hawkins, of London, must ever be remembered as amongst its earliest practical promoters. Charles Clay, of Manchester, however, the first great ovariotomist in this country, Brown, and particularly Spencer Wells, of London; Keith, of Edinburgh; Koeberle, of Strasburg, Sköldberg, of Stockholm; and Atlee, of America, with Hutchinson, and possibly the present writer, have by their successes fairly overcome all prejudices, and rendered the operation an established and accepted one. Without going into the details of statistics, which are now no more needed in this than in other large operations, it may be confidently asserted that the operation is not placed in too favourable a light when it is said to be successful in 3 out of every 4 cases, good, bad, and indifferent, and in at least 9 out of 10 selected cases. Sir Spencer Wells informs us, as the result of his unrivalled experience, that out of his

Successful in two out of three cases.

1000 cases 232, or 23·2 per cent., died, whilst T. Keith lost only 41 out of 381 cases, or 10·7 per cent. Lawson Tait tells me that with the year ending 1883 [he had 209 cases of removal of one or both ovaries for cystic disease with but 7 deaths, or a mortality of 3·3 per cent., and that of 36 cases of operation for cystic disease of the Fallopian tubes he had no death. "If ovarian tumours," he adds, "are operated upon as soon as they are discovered and never tapped, there would be a mortality hardly perceptible."

Early operation advocated.

"I have become," writes Spencer Wells, "more and more disposed to advise the removal of an ovarian tumour as soon as its nature and connections can be clearly ascertained, and it is beginning in any way, physically or mentally, to do harm, since the risk of the operation under such circumstances is certainly less, and the possible evils of delay are eluded."

When delay must ensue one of the minor methods of palliative surgical treatment may be required, such as tapping, tapping and drainage, incision, or tapping and iodine injection.

On Tapping.

Tapping.

This operation may be required for diagnostic purposes, and for relief when other operative measures are necessarily or wisely postponed or have been rejected. It should always be practised once in monocystic tumours, since in such it may possibly prove curative, and probably postpone operative interference for years. It is not to be recommended in compound or semi-solid tumours. Spencer Wells, however, maintains that one or more tappings do not increase *considerably* the mortality of ovariotomy.

Injection of Iodine.

Injection of iodine.

In the simple or *monocystic* ovarian tumours, when the diagnosis is clear, the treatment by injection of iodine may be employed. M. Boinet says that out of 45 patients suffering from this disease, 31 were cured, 5 had relapses, and 9 died. Sir J. Simpson performed it in about 20 cases with good success, only one case dying; while Dr. Tyler Smith found that out of 10 cases in which this practice was followed 2 only were satisfactory, and 2 died. Dr. West in 8 cases had one cured.

Injection uncertain and not free from danger.

The method at the best is uncertain. Spencer Wells does not advocate it. In the majority of cases it does no good, and may even be followed by a fatal result. It is applicablo only to simple cases of ovarian or extra-ovarian cysts.

Treatment by Incision.

Treatment by incision.

This method is only applicable when the operation of ovariotomy is found impossible from the adhesions or attachments of the tumour. Under these circumstances in certain cases it is of immense value. In 1877 I had this truth illustrated in the person of Amelia R—, æt. 20, who had recognised the presence of an abdominal tumour some months before she became pregnant. After the confinement, which was normal and the child alive, the tumour grew rapidly, and when she came under my care her abdomen measured fifty-six inches in circumference.

I operated upon her, but having found a monocyst universally adherent, I emptied it and evacuated many quarts of a viscid fluid, washed the cyst well out with iodine water, dried its cavity, and then drained it. For about a week there was some draining of serous fluid, but there were no constitutional symptoms. The cyst was irrigated daily with iodine water. By the eleventh day the cavity had considerably shrunk. On the twenty-fifth it would not hold an ounce of fluid. By two months it had quite healed, and the woman returned home.

I have performed a like operation to the above in three or four other cases where suppuration existed, and with success.

When Operation is required.

When ovariotomy is called for.

Cases of the polycystic or dermoid kinds should, as a rule, be operated upon as soon as they become sources of local or constitutional distress. "Justice," says Wells, "in these cases demands a most positive recommendation of excision with a warning against delay." "Every ovarian tumour," writes Schroder, of Berlin, "ought to be removed as soon as it has been discovered."

When not called for.

It should not be entertained, however, when other organic disease is present, or when the local disease is clearly cancerous. The operation is a formidable one, but if the general condition of the patient be good the prognosis is favorable even when the tumour is large and looking unfavorable for removal.

The *size* of a tumour has not appeared to have had much influence on the result, although when it is solid and requires a large incision for its removal the dangers are increased; small incisions, without doubt, being better than large.

Adhesions to the abdominal walls, parietes, or omentum, have but little influence upon the mortality; but pelvic adhesions are always grave and visceral dangerous.

The *length of the pedicle*, when the clamp was used, was a matter of importance, short pedicles adding to the danger of the case by necessitating dragging of the uterus upwards. At the present time when clamps are abandoned and the intra-peritoneal method of ligating the pedicle and dropping it in, is the common custom, the length or shortness of the pedicle is of small importance.

The *breadth or thickness of the pedicle* is, however, a question of consideration, since a broad pedicle of necessity requires many ligatures, and a thick one is difficult to ligate with safety.

On the Operation of Ovariotomy.

The operation

The preliminary treatment of a patient about to undergo the operation of ovariotomy need not differ in any way from that which experience has taught us to be called for, previous to any other capital operation. We should do our best to raise the standard of health by all those general hygienic and other influences which are well known to act beneficially, such as good air, simple nutritious diet, a fair amount of stimulants, and the administration of some tonic. Let the patient take exercise when she can without pain, and be careful that it is kept within the limits of fatigue, that it be taken on level ground, and that no shaking or straining be on any account allowed; and, when she is at rest, the half-reclining position ought to be usually assumed. For a day or two before the operation, however, exercise, even when possible, is not to be advised, as quiet and repose are then of some

Diet.

Exercise.

Rest a day or two before operation

essential service. The urine should be carefully examined, and if scanty and concentrated the operation must be delayed. Lithia water and alkalies are always useful in exciting a free secretion of urine and in making it clearer.

As a tonic medicine, iron appears to be of real and important value; it has apparently an influence for good which other tonics do not possess; it is no more useful, however, before the operation of ovariotomy than before any other capital operation, though it is as good, and I have often thought that in hospital practice wounds are less prone to inflame, and erysipelatous affections are less common under the influence of this medicine than when no such preliminary treatment has been adopted. In peritoneal operations, this point is of primary importance, and, as a consequence, the adoption of this practice should be recommended. The form of iron I prefer is the tincture of the perchloride, twenty drops of which, combined with a like quantity of spirits of chloroform or of syrup of lemons or tolu and a drachm of glycerine in water, forming a pleasant draught.

Tonics or iron to be preferred.

The bowels of the patient should be gently opened two days previously by such a mild aperient as castor oil, or a draught composed of ten grains of rhubarb and twenty of sulphate of potash in some aromatic water, and, on the morning of operation, the large intestine should be washed out with a warm water enema, but nothing like powerful purgation should be allowed under any consideration. Care should also be observed that the catamenial period has passed for at least a week previous to the operation, as all ovarian excitement is necessarily injurious at such a time, and should be avoided. I have known cases of ovariotomy, however, undertaken without any consideration of this point, and believe that under such circumstances an untoward result is to be expected.

Attention to the bowels.

Avoid catamenial period.

In hospital practice the patient should as much as possible be isolated from all others and kept in a private room in which good ventilation exists; a special nurse should also be secured, who is not only entirely trustworthy, but understands how to use a female catheter. Country patients should not be brought into town unless an urgent necessity exists; as there is little doubt that the atmosphere of a large city is not so conducive to the rapid reparation of a wound as fresh country air. In abdominal surgery, this influence for good is of great value, and should not be thrown away unless from necessity.

Isolation and good ventilation.

Country air preferable.

The Surgeon who is to operate, as well as his assistant, should not allow themselves, for a few days before the operation to visit the post-mortem or dissecting room, nor should they handle any morbid preparations. Erysipelatous affections and all contagious diseases should also be shunned as much as possible; indeed, the same rules which are observed by the careful obstetric practitioner are necessary to the Surgeon who undertakes the operation of ovariotomy; since the same subtle poisons which are recognised by all to be hurtful to the puerperal woman, act with equal force upon the subject of ovarian as of other diseases, when submitted to operation, and, as a consequence, should be studiously avoided. It follows, therefore, as regards the lookers-on at an operation, and all who may come in contact with the patient, that none who may bring infectious or contagious disease should on any account be admitted. The physician who is attending a case of puerperal fever is looked upon as a possible poisoner as far as

Operator and assistants to avoid post-mortems and contagious diseases for the time.

Care to prevent contagion.

concerns the puerperal woman. The medical attendant of a scarlet fever case, of erysipelas, or other contagious disease should be regarded in the same light in the presence of an ovariotomy operation, and should be excluded. Hence, in hospital practice, great care is needed to exclude all such possible means of injury as have been briefly enumerated.

Hospital rules in respect to operation.

I need hardly allude to the necessity of all bed and bedding, blankets, sheets, and hangings being perfectly fresh; all sponges being *new*, soft, well cleansed, scalded, and free from soap and grit; and every instrument to be employed being scrupulously clean. The hands of the operator should likewise be thoroughly cleansed from soap just previous to the operation, and be well warmed, for manipulation with a cold hand cannot but prove injurious to an exposed peritonæum.

Temperature of room.

The Temperature of the Room in which the Operation is Performed.—There is still some difference of opinion on this point, among operating Surgeons, Dr. Clay, of Manchester, Peasle, of America, and others, advising that the operating room be heated to 75°F. or 80° F., and a good supply of moisture engendered by the diffusion of steam, while Wells and others make no such rule. Speaking from my own experience, I have no faith in the adoption of such a practice. I would have the room heated to a comfortable temperature, 65 degrees being amply sufficient, since a greater heat acts as a powerful depressant upon the patient, and can do no good. A warm room with good ventilation is what I always seek in preference to a hot one, with closeness. A cold damp room under all circumstances is to be condemned.

Position of patient.

The Position of the Patient.—The horizontal position is that which patients suffering from ovarian disease can rarely assume, and when the tumour is so large as to require ovariotomy this position becomes almost impossible. As a consequence the half-reclining position is the most comfortable for the patient and convenient for the operating Surgeon. It is the posture I have invariably adopted in the cases which have fallen into my hands, and I know of no good reason why it should be changed.

Semi-recumbent position best.

The semi-recumbent position affords all the advantages which have been claimed for other postures without their evils; in it the tumour can readily be removed from the abdominal cavity, and with care, its fluid contents can without difficulty be prevented from passing into the peritoneal cavity. There is also abundant room for every manipulative act that can be required.

Anæsthetics. Their value.

The Administration of Anæsthetics in the Operation.

Among the many incidental advantages which the introduction of anæsthetics has afforded beyond that of relieving pain, few are greater than that of obviating hurry, a point of critical importance in ovariotomy; and there can be little doubt that the success of the operation has thus been greatly influenced by their use.

It is true that operations for the removal of an ovarian tumour were undertaken before the introduction of any anæsthetic, but we all know how fatal were their results and how exceptional was recovery. Those who had an opportunity of witnessing the performance of an operation under such unfavourable circumstances can hardly wonder that so many patients succumbed to the practice, although they might be surprised that any were found to convalesce. To see a patient writhing under the agonies of an abdominal section was enough to make the hardest heart turn with horror, and to witness the Surgeon's hands within the abdomen of a struggling woman, in his endeavour to remove an adherent growth, was almost sufficient to make any professional spectator decide that such an operation was really unjustifiable.

Gentleness enforced.

Hurry and force strongly condemned.

How, in such a case, was it possible for a Surgeon to be quiet in all his movements, gentle in his manipulations, and thoughtful over the difficulties which of necessity present themselves in an ovarian operation, when the cries of the patient's agony stimulated him to expedition, and her struggles forbade gentleness? All Surgeons who have operated upon these cases will agree that success even under favorable circumstances is only to be acquired by attention to these points; that hurry in any operation is always bad and unjustifiable, while in ovariotomy it is destructive; that force is never to be employed in any case where art will answer; that in ovariotomy all blind force and dragging is to be strongly condemned; and that in a proceeding in which steadiness in operating, gentleness in manipulating, and thoughtful attention to every detail are absolutely essential to success, the safety of the patient must depend upon her quietness and passiveness under the Surgeon's treatment.

Under these circumstances the value of some anæsthetic cannot be too highly praised, for the patient by it is not only rendered insensible to pain, but her perfect quiescence is guaranteed, and her passiveness under the hands of the operating surgeon completely ensured.

Vomiting does not contra-indicate use of chloroform.

The vomiting that occasionally follows is the only argument against the inhalation of an anæsthetic, but this is an evil which must be endured for the sake of the positive good it affords. By the use of the nitrous oxide gas followed up by ether, or of the chloroform mixture, of alcohol one part, chloroform two, and ether three parts, as recommended by the Chloroform Committee of the Royal Med. and Chir. Society, vomiting is certainly less common than after the use of chloroform alone, and as a general anæsthetic it should be employed. When chloroform or bichloride of methylene is used it should be given by "Junker's" spray apparatus.

Extent of incision requisite.

Extent of the Incision into the Abdominal Parietes.—The temperature of the room, the position of the patient, and the propriety of the administration of anæsthetics having received our attention, the operation itself next claims consideration, and the first thought naturally is as to the extent of abdominal incision required, as there is still a want of unanimity in the practice of different surgeons upon this point.

Care to have the bladder empty.

Before commencing, the careful Surgeon, standing on the right hand of the patient, will see that the bladder has been emptied by means of a catheter; the linen of the patient well drawn up out of harm's way and free from the chance of becoming soiled, by the use of waterproofing; the limbs of the patient well protected and kept warm by a pair of drawers, and covered by a clean sheet, either with or without a blanket, the abdomen covered by a long piece of waterproofing with an opening in the middle eight inches long by six wide, with its inner surface rendered adhesive by a coating of plaster. He should see also that all his assistants are carefully arranged, and special duties assigned

Incision may be long or short.

Short preferred.

When tumour large and semi-solid, then long incision.

to each, and that every instrument that may be required is clean and nigh at hand. He should proceed to make his incision as soon as the patient has been brought completely under the influence of an anæsthetic; though previously he should determine as to its length. From Mr. Walne, Sir J. Simpson, and Dr. Clay's practice it might be argued that the long incision should always be adopted, since their success has been great, and in their practice the long incision has been invariably employed. From the practice of Dr. Keith, Sir Spencer Wells, Lawson Tait, and others, the short incision would appear to be the better, for their success has at least been as good as that of Dr. Clay and others, and as a rule the short incision has been the one selected. I regard the truth as between the two extremes. When the tumour can be removed with facility by means of a short incision, a long one is clearly not required; and, when the tumour is monocystic or nearly so and free from abdominal adhesions, it may be so removed. But when the tumour is large and semi-solid, or when adhesions exist which cannot be readily broken down by the employment of gentle traction upon the growth, it is the best practice, doubtless, to make a long incision; as by so doing the removal of the growth is much facilitated, the causes of its abdominal retention and the connection of the adhesions are satisfactorily ascertained, and, as a consequence, can be dealt with with greater safety.

Commence with short, and enlarge if necessary.

My own practice has hitherto been influenced by such a conviction; and I have in all cases commenced the operation by making a short abdominal incision, and in many have been enabled to remove the tumour without further trouble. But in certain examples, in which difficulties appeared, and in which it was clear that adhesions existed, for the breaking down of which some force would have been required, and some working in the dark called for, I have been induced to increase the length of the wound upwards, even for an inch or two beyond the umbilicus, regarding such an increase of the incision as unimportant in comparison with the evil effects of violence, and dragging upon the tumour for the purpose of its removal; or the blind tearing down of the abdominal or visceral adhesions which detain the growth.

Not to remove a large growth through too small an opening.

I have never seen any evil effects from the long incision when made under the circumstances I have just indicated, but have, beyond doubt, seen the bad results of an opposite practice, of violence which has been employed in an attempt to remove a large growth through a small opening, or to tear an adherent one from its abdominal or visceral connections.

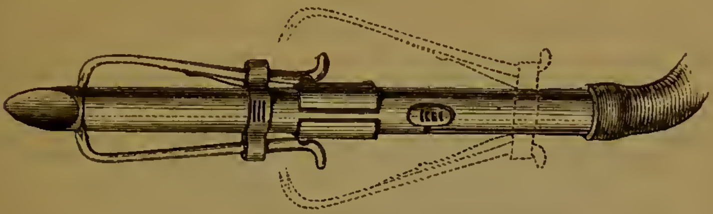
Incision to be sufficiently low.

The incision should also always be made sufficiently low. If too high, considerable traction upon the pedicle of the tumour must be made to bring it into sight, and, with the tumour, the uterus will also be drawn out. This traction is always injurious, and should be avoided. When the lower end of the wound is too high up this traction of the parts becomes unavoidable; by extending the incision downwards towards the pubes to a point corresponding to the upper part of the healthy uterus, or about one inch above the pubes, this evil can be prevented, and, consequently, the practice I have just advised should invariably be adopted.

On Tapping the Cyst.

The cyst, having been exposed, ought to be tapped, and for this purpose the instrument represented in Fig. 407, as made for me by Mr. Millikin, in 1864, is the one I prefer. It includes not only a trocar and canula, but a vulsellum forceps, which slides upon the latter, and, by being made to grasp the cyst walls, holds the instrument firmly in its position, thus enabling the Surgeon to make traction upon the tumour for the purposes of its removal.

FIG. 407.

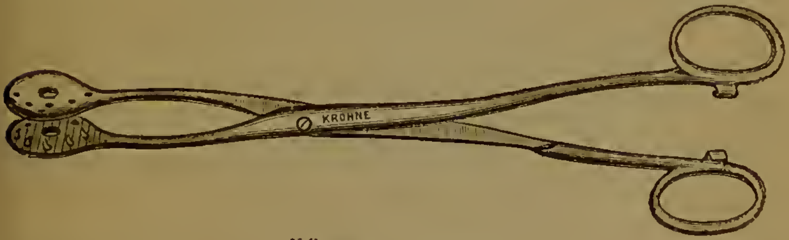


Trocar and canula for tapping with movable forceps.

On removal of cyst.

When the cyst has been emptied, and is of a simple nature, its removal, unless adhesions exist, is readily effected, but when it is solid or very compound it may be necessary, to allow of its extraction, to lessen its size by breaking down its contents, and for this purpose the Surgeon must make a free opening into the cyst, and introduce his hand into its interior, the orifice of the opening into the cyst at the same time being held well open and forward by forceps (Fig. 408) adapted for the purpose. By these means the most compound cyst may be broken down and removed. When the cyst is so adherent to the abdominal parietes as to render it difficult for the Surgeon to distinguish the cyst-wall itself from the parietal layer of peritoneum, the plan adopted by Sir Spencer Wells, of emptying the cyst and seizing its posterior or upper wall from within by forceps and inverting it, is a good one, the cyst then peeling off on good traction being made.

FIG. 408.



Nélaton's cyst forceps.

On Adhesions and their Treatment.

On the treatment of adhesions.

When the incision through the abdominal walls has been made, and the smooth glistening surface of the visceral peritoneal covering of the tumour recognised, the Surgeon may be satisfied that the abdominal cavity has been fairly opened and the tumour exposed; and when the ovarian cyst on each respiratory act is seen to move freely within the abdomen, there is a strong probability, if not certainty, that the tumour is free, and the complication of adhesions is not likely to be severe; for when the tumour is fixed to the abdominal walls this mobility of the cyst is not present. Fibrous or fibro-cystic tumours of the ovary or uterus usually have a fleshy or muscular appearance.

Varieties of adhesions.

Adhesions may present themselves on the completion of the abdominal incision in two forms. *Firstly*, as forming a complete and compact union between the peritoneal covering of the cyst and the abdominal peritoneum; *secondly*, as loose and fibrous connective bands; and *thirdly*, as visceral adhesions.

First, firm, and compact union with parietes.

When a firm and compact union exists between the cyst and the abdominal peritoneal membrane, the Surgeon will have lost his chief guide as to the depth of his abdominal section, and under these circumstances he may experience some difficulty in deciding whether the abdominal cavity has been opened or not; he must consequently be careful in his procedure, for he is not far from the possibility of perpetrating a fatal error—the separation of the parietal peritoneum from its muscular connections; but this error, however, can be avoided by merely extending the abdominal incision upwards, until the distinct line of separation between the cyst-wall and the abdominal peritoneal membrane is clearly seen.

Care in avoiding separation of peritoneum from muscles.

The next step of the operation consists in the breaking down of adhesions, which may be done by the careful introduction of the finger between the cyst-walls and the parietal layer of peritoneum.

Mode of breaking down adhesions.

And here some force is perfectly justifiable, for if the adhesions are confined to the abdominal parietes and can be torn through, there is rarely much subsequent danger to be apprehended. Extreme care, however, is required at this stage of the operation. The Surgeon should, by the introduction of his finger, make out the extent of the adhesions and test their strength. If they should be found numerous and too firm for separation the operation at this stage had better be abandoned and the wound closed; or, should many visceral adhesions of a firm character be present it would be well to follow the same practice, as the latter are much more dangerous than those merely attached to the abdominal walls. It is, indeed, difficult, if not impossible, to describe with anything like accuracy what extent or character of adhesions would justify the Surgeon in abandoning an operation once begun and then closing the wound. The careful study of reported cases and experience alone will enable him to decide with certainty upon these points.

Care in separating the visceral adhesions.

Yet, as a broad rule, it may be asserted that, while parietal adhesions may be fearlessly treated when they can be divided, those connecting the cyst with the viscera and the pelvis should always be regarded with alarm; and that the amount of force permissible in the treatment of the former class of cases would be quite inexcusable when the viscera are concerned. Wells's method of emptying the parent cyst, passing one hand into its interior, grasping its back and inverting it, the back part of the cyst being withdrawn through the opening made in its front, is an excellent one.

Hæmorrhage to be arrested.

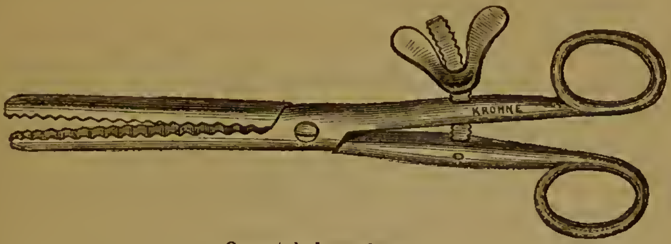
The fear of hæmorrhage from the lacerated adhesions should always be present to the Surgeon, and the torn surface should be carefully examined with a view to the arrest of any bleeding.

Omental adhesions.

Omental adhesions should be particularly examined with care and torn through with caution, for they are very vascular and cannot be treated with too much consideration. As a rule, they should be divided and secured with a fine ligature of silk or carbolised catgut. Their forcible separation is always bad. Spencer Wells's forceps for holding the omentum (Fig. 409) whilst the Surgeon secures the vessels is invaluable. Firm band-like adhesions may be similarly treated. The ends of each ligature may be cut off and the knot left in.

When the incision has been made, and no adhesions exist between the cyst and the internal abdominal walls, it appears to be an unnecessary practice for the operator to introduce his hand into the abdominal cavity with the view of learning whether they exist or not. Adhesions in front must necessarily be broken down, and this can generally be effected by the finger of the operator introduced at the margin of the wound. As the cyst empties, these adhesions are necessarily brought forward, but when they do *not* exist, the peritoneum escapes even the touch of the hand of the operator. In complicated and exceptional examples of this operation it is clear that this practice cannot be followed, but in the more ordinary and simple cases it is most applicable. In many examples which have come into my hands the value of this advice has been well proved, for in them the peritoneum was touched only by the knife and needle.

Fig. 409.



Omental clamp forceps.

As the tumour is being extracted care should be observed to guard against the protrusion and exposure of the intestines and omentum, and this is best done by the introduction of flat sponges, a sponge being tucked in and spread out beneath the parietes as the process of extraction of the cyst and exposure of the pedicle is going on.

The Treatment of the Pedicle.

Treatment of the pedicle.

At the present day the pedicle is, as a rule, tied in two or more segments, according to its size, with carbolised silk, the ends of the ligatures are cut off close to the loop, and the pedicle with the ligatures dropped back into the pelvis. This method is doubtless a great improvement upon the clamp and other forms of practice.

Variety of methods.

In France, Maisonneuve twisted off the cyst by continued torsion, leaving the pedicle to fall back into the abdomen; whilst Nélaton preferred to fix the pedicle externally, and secure it by means of a common clamp. In Germany, Martin and Langenbeck cut through the peritoneal covering of the pedicle by a circular incision, cut off the tumour, tied each vessel separately, and fixed the pedicle to the walls of the abdomen by means of a double ligature. Dr. C. Clay fastened the pedicle by a double ligature, cut off the tumour, and, having allowed the pedicle to drop backwards into the pelvis, brought the ends of his ligatures out through the lower ends of the incision. Dr. Tyler Smith followed the same treatment, but dropped both pedicle and ligatures, which are cut off close, into the pelvis, and then closed the wound. S. Wells and T. Keith for years fixed the pedicle externally by means of a clamp, but Wells, Thornton, and most operators now use the ligature, and Keith the cautery, as first employed by Mr. B. Brown and Skölberg, dropping the cauterised end of the pedicle back into the pelvis. Atlee, of America, employs the écraseur. In my own practice I now always employ the ligature.

Dropping in of the pedicle.

The plan of treatment now principally adopted of dropping in the pedicle with the divided ligature was first practised in 1829 by David Rodgers, of New York. His patient made a good recovery.

The practice did not, however, meet with general approval. It was too bold and inconsistent with all past experience and professional prejudices, and fell to the ground. It was repeated at intervals by other Surgeons with tolerable success; it has now gained a strong hold on the professional mind, and become a general practice. I may mention here that Sir B. Brodie had some confidence in this practice, for in 1843, when discussing the case upon which Mr. Aston Key had operated without success, at Guy's Hospital, he expressed his belief that the right treatment of the pedicle was to drop it in and close the wound, and that if success could be secured it would be by such means. I make this statement on the authority of Dr. H. Oldham, who heard the remark.

Brodie's view.

What becomes of the ligated pedicle with the ligature or of the cauterised extremity is a point of interest, and it may with some confidence be said that the ligated or cauterised end does not slough, nor does the ligature act as a foreign body. In a case of my own in which the pedicle was secured with carbolised catgut and dropped in, with a good result, no traces of the ligature were visible a year later when the patient died from some other cause than the disease—indeed, there was not even an adhesion, for the fimbriated end of the divided pedicle was free.

'St. Barth. Hosp. Reps.,' vol. 13 and 14.

Dr. Doran has also found from a careful examination of ten cases at variable periods after ovariotomy, that "a communication between the distal and proximal parts of the stump is established by inflammatory plastic effusion, and the ligature is unravelled by granulation cells insinuating themselves between its fibres."

Toilet of the Peritoneum.

Toilet of peritoneum.

When the pedicle has been secured, all bleeding points should be carefully looked to, particularly at the seat of adhesions; and all vessels should be twisted, or ligatured with fine carbolised silk or catgut.

The second ovary with the uterus should then be examined, and the pelvis thoroughly cleaned with soft sponges. Indeed, the greatest care should be observed in what is called the "toilet of the peritoneum" so that bloodclots and fluid should be carefully removed. In my early days, I, in common with others, did not see the necessity of this care. When this important measure has been completed, a flat sponge should be introduced within the wound and left till the sutures have been introduced.

Treatment of the wound.

Treatment of the Wound.—The operation completed, the abdominal cavity cleansed, the opposite ovary examined, and all signs of hæmorrhage absent, the Surgeon may then proceed to the closure of the wound. He should do this by means of deep and superficial sutures; those of silk plat as sold by fishing-tackle makers are the best. These sutures should be inserted at intervals of an inch, and made to include

Should the peritoneum be included?

the muscles and peritoneum; intermediate superficial sutures being inserted through the skin. When union has taken place, *i.e.* any time between three and six days the sutures should be removed, no object being gained by leaving them longer *in sitû*.

Drainage-tubes.

Drainage-tubes.—In all complicated cases where the peritoneum has been much involved and there is a probability of hæmorrhage or serous exudation, a drainage tube should be introduced at the lower angle of the wound. One made of glass is better than the india-rubber.

The After-Treatment.

After-treatment.

Whenever a patient has taken an anæsthetic, it is wise to keep the stomach as quiet as possible, and as the benefit of an opiate after the operation is always great, it is wise to administer it by the rectum. In abdominal operations, this practice is of great value, and, for some years, I have been accustomed to give a half grain of morphia suppository after every ovarian operation, as well as after others of hernia, ruptured perinæum, &c. The suppository should be administered before the patient has recovered from the effects of the anæsthetic, and care should be taken that it be passed well into the rectum. If pain is felt, the suppository may be repeated, but it is rarely necessary to administer it more than once a day, namely at bedtime. The patient's room should be kept cool and airy, as in other cases of operation. For the first two days, milk or barley-water form generally the chief diet; but should sickness supervene as a result of the anæsthetic, ice and milk, or ice and soda water should be administered; and everything should be cold. If sickness continues, food ought to be given two or three times a day by the rectum. As soon as the stomach will admit, fresh meat, brandy, and wine ought carefully to be given, the object being in these cases, as in all others of general surgery, after the first three days, to keep up the powers of the patient, and so enable nature to complete the cure. The application of a Leiter's coil to the abdomen I have found of great advantage, and an ice cap to the head is beneficial when the temperature rises above 102°. The urine ought to be drawn off periodically, and when the bowels require relief their action should be rendered easy by the use of enemata. The bladder should never be allowed to become distended, nor the bowels be left loaded too long.

Morphia suppository.

Diet.

Value of ice

Catheterism.

Opium.

On the use of opium a few remarks remain to be made, for upon this point the practice of Surgeons appears to be undergoing a change. In the early operations of ovariotomy it was extensively employed, and at the present time some are still free with its use, but there is good reason to believe that in this operation, as in others, a very free administration of the drug, in every case, is not attended by such good results as could be wished; and that in a patient under its full influence a wound does not repair so rapidly and favorably as in another where natural processes are allowed to progress without interference. Opium carefully given to allay pain and cause sleep is a drug upon the value of which there cannot be a doubt, but opium administered with sufficient freedom to bring, and repeated often enough to maintain, a patient under its influence, is a drug against the use of which a Surgeon should be on his guard. In ovarian cases it ought not to be given in larger quantities than sufficient to allay pain and secure sleep. A patient should not be kept under its full influence unless there are specific reasons for it. It is best administered by the bowel, being less liable to cause injurious effects, and more likely to produce good, since it is absorbed as rapidly by the rectum as by the stomach, and in abdominal operations it tends much to maintain that quietude of the bowels which in all such cases is so desirable. In my own practice I have been accustomed for some years to administer opium by the bowel in preference to the stomach in all cases of abdominal surgery.

After the operation of ovariotomy patients may become pregnant. Many of mine have done so, and in one case, recorded in the 'Gaz. Méd. de Paris,' 1873, a patient had twins, one male and the other female.

Ovariotomy in pregnancy.

Ovariotomy may even succeed when performed upon a pregnant woman. Sir Spencer Wells has reported nine such operations with eight recoveries. In five of the nine cases pregnancy proceeded, and living children were born after natural labour, and in all these the operation was performed within the fourth month. In the other cases a miscarriage occurred. He lays it down as a rule that, in cases of multilocular or solid tumour, the tumour should be removed in an early period of pregnancy, and if an ovarian cyst should burst during pregnancy removal of the cyst and complete cleansing of the peritoneal cavity may save the life of the mother, and pregnancy may go on to the full term.

On the Treatment of Suppurating Ovarian Cysts.

On suppurating ovarian cysts.

When an ovarian tumour is breaking down and undergoing disorganizing or suppurative changes, whether spontaneously or after tapping, it has been already stated that it is the Surgeon's duty to interfere and to remove what is a serious source of constitutional irritation, and which, if left to itself, must to an almost certainty destroy life. This should be done by means of an exploratory operation. When the tumour can be removed as a whole so much the better; but when it has contracted such adhesions with the parts around as to be practically immovable, as much of the tumour should be turned out of the parent cyst as possible, and the cyst itself stitched to the margins of the wound, the suppurating cavity being well washed out once or twice daily, and a drainage tube left in. I have recorded an excellent example of this practice in 'Guy's Hosp. Rep.' for 1868, where a woman, æt. 34, was successfully treated by these means; and more recently, in 1874, I removed a suppurating ovarian cyst associated with acute peritonitis with a successful result.

Strangulation of ovarian cysts.

The strangulation of ovarian tumours by rotation is not rare. Rokitansky, in 1865, published a paper upon it. It means that the movable ovarian tumour, under certain circumstances, may rotate more or less upon its axis, and so twist the pedicle. If the twist happens to be slight no important interference with the circulation of the vessels through it may be brought about; but if it should be enough to prevent the return of the venous blood from the ovary, congestion of the part strangulated, followed by exudations of serum, and possibly of blood, will follow, which give rise to symptoms not unlike those of strangulated bowel. Indeed, cases of this kind have been regarded as such. In Ann R—, æt. 28, under my care Feb., 1884, the difficulties of diagnosis were great, the onset of the symptoms having been sudden, the local pain severe, and vomiting persistent. The symptoms had appeared after a railway journey.

Case.

I operated at once, and removed a large polycystic tumour, which was black from congestion, and with a Fallopian tube rigid with blood; also some blood from the peritoneal cavity. The pedicle was bloodless where twisted. Had relief not been given, the whole tumour would have become gangreuous. As it was, the patient made a rapid recovery.

Wells reports two cases of sudden death from hæmorrhage into the peritoneal cavity from this cause.

Hysterectomy.

Hysterectomy.

Operations upon the uterus have been gradually growing in favour, and the fact is probably due to the experience which ovariotomists have accidentally acquired in the removal of uterine tumours which have been mistaken for ovarian. They are now frequently undertaken for cystic disease of the uterus and fibroid tumour, whether growing as pedunculated, sub-peritoneal, or intra-mural growths, and much success has attended the practice.

The operation has likewise been undertaken for cancer, but experience has not given much support to the measure.

For fibro-cystic tumours the operation is a good one, for these growths steadily increase, and do not, as the fibroids, cease to grow when menstruation has passed away.

Fibro-cystic uterine tumours present all the external features of the more solid ovarian, and cannot be diagnosed, more particularly when a pelvic examination reveals but little. When the uterus can be made out to form part of the tumour and to move with it; when the uterine sound can be passed freely into the cavity of the uterus and be made to extend far beyond its normal distance; when at each monthly period the flow is profuse; when the tumour is fixed well in the pelvis and the abdominal veins, &c., are turgid from its mechanical pelvic pressure, something more than a suspicion of its fibro-cystic nature may be formed; but when none of these symptoms are present the diagnosis cannot be made with certainty.

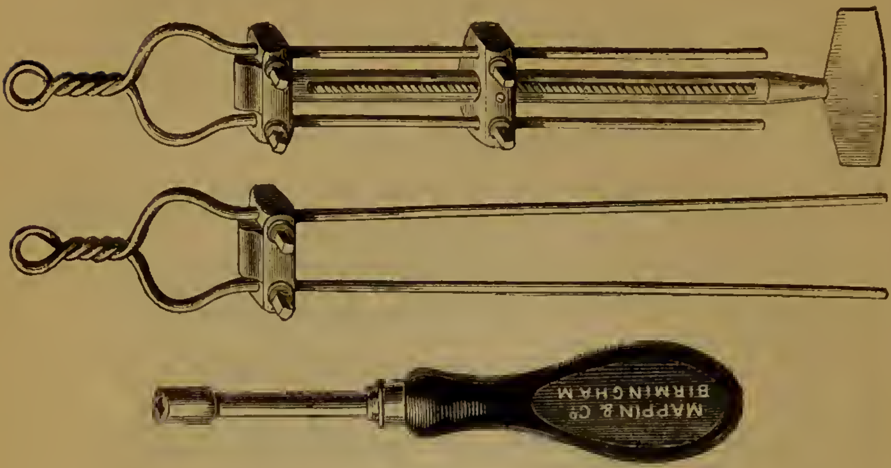
Successful operations.

The operation of extirpation of the uterus has been performed with success by Clay of Manchester, Storer of Boston, Koeberle of Strasburg, Schroeder of Berlin, Keith of Edinburgh, Wells, Thornton, Tait, Davies-Colley, and myself. My own case was in the person of Miss M—, æt. 26. The tumour had been growing for three years, and for this she had been under the care of Dr. Oldham, who believed the case to be one of ovarian disease. He sent her to me for operation. On May 19th, 1871, I operated, and, finding the uterus and both ovaries diseased, I removed the whole, fixing its base with a large clamp. An uninterrupted recovery took place. Full particulars will be found in the 'Trans. of Obstet. Soc.,' 1873.

I have operated on three other cases, but not successfully, one patient dying from hæmorrhage caused by the rupture of a pelvic vein, and the others from the shock and peritonitis. In two I removed the uterus and its tumours by means of the chain écraseur made by Meyer, of Great Portland Street. The chain should be passed well round the base of the growth, and screwed up slowly. I would, however, now use Lawson Tait's clamp (Fig. 410).

Operations for *uterine fibroids* have been more frequent than for cystic uterine disease, and likewise more successful. They should not, however, be undertaken unless the tumours form decided obstacles to the patient's progress through life, or give rise to troublesome hæmorrhage. Many of these tumours cease to grow or to be a source of trouble after the menopause, and many never interfere even with a woman's comfort.

FIG. 410.



Tait's clamp.

Case. 1873 I removed a sessile fibrous tumour the size of a large cocoa-nut from the right cornu of the uterus at the same time that I removed a large ovarian tumour from the left ovary. The lady, æt. 51, was a patient of Mr. Collambell's, of Lambeth, and recovered.

Mr. Thornton, who has had good experience of this operation, states "that large pedunculated sub-peritoneal fibroids, when diagnosed, should be removed, even though they may only cause inconvenience at the time." He adds, however, that "operations for intra-mural fibro-myomata are specially dangerous, since they naturally involve the opening of the uterine cavity." The operations are far more formidable than ovariotomies. "If you have to think twice," writes Keith, "before advising a woman to have ovariotomy done, you must think fifty times ere you recommend her to have a uterine tumour removed." Neither Wells nor Thornton advocate their removal indiscriminately, but rather the adoption of Battey's operation, or the removal of the uterine appendages to check the growth of the tumour when it gives rise to troublesome hæmorrhage.

Battey's operation

Thornton has performed Battey's operation fifteen times, and with success, ten of the patients having lost their tumours, in two the tumours are lessening, and the remaining three are recent cases.

Lawson Tait has ably advocated this same measure, and has had much success. He writes that the operations for the removal of the uterine appendages for uterine hæmorrhage, when associated with uterine tumours, has been accepted.

The operation. *The operation of hysterectomy.*—In a general sense the same principles of practice are applicable to these cases as to those of ovarian disease. The one difficulty is the treatment of the pedicle where such exists, or of the divided uterus.

Treatment of pedicle.

When a fibroid tumour is pedunculated there is no difficulty, as the pedicle may be tied in halves, and dropped back, as in an ovarian tumour. When it is large and thick possibly Thornton's method is very applicable, as described by him ('Brit. Med. Journ.,' October 13, 1883).

"If the pedicle be transfixed, hæmorrhage from the puncture is liable to occur and very difficult to control. I therefore first secure the pedicle by a ligature tied firmly round the whole of it, then threading an end of this ligature through the needle again, transfix the pedicle on the distal side of the first tie, and proceed to ligature in halves or smaller pieces if necessary. This method renders slipping of the ligature impossible."

Under the above circumstances the pedicle may be dropped back, and the abdominal wound closed.

Outside wound.

This practice must not, however, be adopted when the uterine cavity is exposed. Under such circumstances the pedicle should be kept outside the abdominal walls. Sir Spencer Wells uses for this purpose a stout pin about the size of a penholder, around which he twists a figure of 8 ligature, the two acting together as a clamp. Koeberlé employs his *serre-nœud*, and it is useful; but Lawson Tait's clamp is probably better, as it can secure a pedicle of any size and hold it securely. Indeed, when a clamp is wanted for any operation no better can be used (Fig. 410). Should there be any fear of the clamp slipping, one or two pins may be passed through the distal side of the pedicle to make it secure.

Value of rubber ligature.

Hegar, of Freiburg ('Berlin Klin. Woch.,' No. 12, 1882), recommends the use of the elastic ligature in the removal of abdominal tumours and organs. He has removed uterine fibroids by this method without hæmorrhage. From many experiments he thinks it is evident that uterine pedicles can be treated without danger by the elastic ligature.

Carl Schroeder, of Berlin, when removing his intra-mural fibroids, uses an india-rubber ligature as a temporary clamp, enucleates the growth, and stitches together the capsule of the growth with different layers of sutures, one suturing the mucous membrane of the uterine cavity, and the other the peritoneal layer, subsequently draining the cavity through the vagina.

Out of 66 patients operated on by him 20 died, or 30 per cent. Of his last 40 he, however, lost but 9, or 22·5 per cent.

L. Tait has had 28 cases, with 6 deaths, or 21 per cent. Spencer Wells has had 39 cases, with 21 deaths, or 53 per cent. Keith has had 17 cases, with one death.

This operation of hysterectomy is the gravest the Surgeon can undertake; when complicated it tries him to the utmost. Let it not be undertaken rashly or without the fullest consideration.

THE SURGERY OF THE MUSCULAR AND OSSEOUS SYSTEMS.

CHAPTER XXVIII.

AFFECTIONS OF THE MUSCLES AND TENDONS.

Contusions.

Contusions.

Contusions of muscles, as of other parts, may occur, and when severe may be followed, not only by want of power, but by absolute wasting. Thus, in 1863, I saw a man, æt. 44, who, five months before, received a severe contusion of the left deltoid muscle from a fall upon the shoulder, and, as a consequence, the muscle had completely atrophied, although there was no loss of sensation over the muscle, and in all other respects the limb was normal.

When wasting takes place, the muscle should be stimulated by galvanism before degeneration has proceeded too far. When due to the want of nerve force there is little hope of any good result being obtained under any treatment.

Subcutaneous rupture.

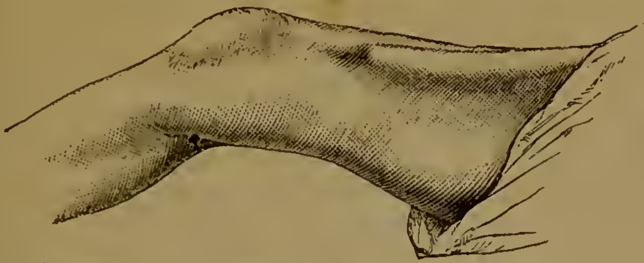
Subcutaneous rupture of muscle to a slight degree, is far from being uncommon, particularly of the deltoid, but its complete rupture is very rare. In most cases of strains, some rupture of a muscle takes place, which often shows itself by the effusion of blood into the part.

At times, a muscle is torn across by over-action, as in tetanus, the rectus abdominis being that most frequently affected, but the psoas has been said by Mr. Earle to be so injured. Sédillot reports that out of twenty-eight cases of ruptured muscle, thirteen occurred at its point of juncture with the tendon. He says also, that rupture occurs only in some involuntary action of the muscle, or, when it is taken unawares.

Examples.

In 1859, I attended a man, æt. 21, who ruptured the left rectus abdominis above the umbilicus, when jumping with some bricks in his hand. He was collapsed after the accident, and when I saw him the next day the two ends of the muscles were so far asunder as to allow the fingers to be placed between them. In 1863 I also attended a man, æt. 65, who, when lifting a cask with his body bent, felt an acute pain in the posterior part of one thigh, "as if he had been struck with a potato;" he fell forward, and was unable to walk. When I saw him two days after the accident the semi-membranosus muscle had clearly been divided at its origin from the tuber ischii; the body of the muscle could be felt as a loose, fleshy mass, and below the tuberosity of the ischium a marked deficiency was present. I have also the notes of a case of complete laceration of the extensor triceps muscle of the thigh above the patella, in a railway inspector, who said that it gave way with a report on his attempting to start off suddenly for a run. In this case there was great effusion of blood into the part within a few hours, which had subsided after the application of ice, the separation of the muscle from the patella being very distinct. In drawing (fig. 411), rupture of the rectus femoris is illustrated, and was taken from a male patient, æt. 42.

FIG. 411.



Rupture of rectus femoris just above patella in a man, æt. 42.

Minor degrees of laceration of muscles are of common occurrence, and often followed for many months by pain, stiffness, and want of power in the part, the pain disappearing for a time to reappear on any over-action of the weakened muscle. These pains are often called rheumatic.

Mr. Poland records in his 'Fothergillian Prize Essay' two cases of complete rupture of the rectus abdominis muscle in the hypogastric region, so that the finger could be laid in the dents between the retracted ends. Both occurred in the wards of Guy's Hospital, and in men of advanced years suffering under organic disease; the one had an advanced stage of bladder and kidney mischief, the sequelæ of old stricture, the other was suffering from a relapse after continued fever. In both, the accident had been caused by a fall across the iron rods of the bedstead in a vain attempt to rise and walk. Both died a few days after the accident, when complete rupture of the rectus was found in the middle of the hypogastric region, and coagulated blood existed between the divided ends as if only just poured out. No signs of repair were present.

Treatment.

TREATMENT.—In all cases of completely ruptured muscle, the parts must be relaxed in order that the divided ends may be made to approximate as much as possible and be fixed at rest, so that repair may not be interrupted. When much effusion of blood or serum follows ice may be applied in a bag; and, when absorption has somewhat advanced, a stimulating liniment hastens recovery and gives comfort. When these are not attended to, repair cannot go on; indeed, as a consequence of neglect, suppuration is by no means a rare result, as is seen in psoas abscess. When the laceration has been complete, permanent weakness will remain, and when the abdominal muscles are at fault, some hernial protrusion of the abdominal contents will take place. In a man who fell from a ship's ladder upon a blunt-pointed iron bar, and had severe rupture of the abdominal muscles attached to the anterior half of the crest of the ilium, a large hernial protrusion existed, and I could press my fist into the opening through the muscles. In such cases some artificial support is permanently needed.

Suppuration as a result.

Compound Laceration of Muscle.

Compound laceration of muscle.

When muscles are lacerated in connection with wounds of the soft parts covering them the injury is grave, and the primary danger of the case as well as the prognosis as to the future use of the part, turns upon the amount of laceration. In compound fractures, &c., this fact is well known.

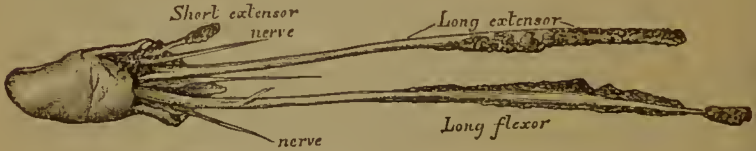
Evulsion of muscles.

Muscle to be replaced.

Evulsion of tendons.

But, at times, muscles are torn out through skin wounds, or are ruptured at the time of the accident, and may even hang out of the wound. When this is the case, the muscle, unless much crushed or injured, must not be cut away, but replaced in position as well as possible, and to further this end the wound in the soft parts may be enlarged. One of the worst cases of this kind I have ever seen I attended with Dr. Mason, of the Barbican. It was that of a gentleman, æt. 22, who, when sleep-walking, fell a height of forty feet out of a window on a glass skylight. Among other injuries he sustained a lacerated wound of his right thigh and complete division of the body of the inner hamstring muscles. When I saw him, a large mass of well-developed muscle protruded from the skin wound. I enlarged the opening in the integument and carefully replaced the muscle, keeping the limb on a splint. In five weeks he was convalescent. A year later he had complete movement of his limb. Entire tendons are sometimes torn out of a limb, and in Guy's Hospital Museum there is a preparation (1367), which includes the last joint of the middle finger with its tendon of the flexor profundus attached. It was torn by a thrashing machine, the accident being followed by tetanus, yet the patient recovered. In another preparation (1119^{65}) figured below (Fig. 412), there is a portion of thumb with the long flexor and extensor and short extensor tendons, together with the nerves torn out by machinery. It was taken from a man, æt. 17, who made a good recovery.

Fig. 412.



Thumb, with tendons, &c., torn out by machinery.

Dislocation of Muscles and Tendons.

Dislocation of tendons.

There is good reason to believe that muscles, like tendons, may be dislocated, although from the way the former are protected by fascia and the latter by fibrous sheaths and bony grooves such accidents are rare. When they occur, they are the result of some sudden and unexpected strain, rick, or twist. In the upper extremity, the accident may occur to the biceps tendon, and those about the wrist. I have never seen a dislocated biceps tendon, but must refer to an able article on the subject by Mr. J. W. White, of Philadelphia, published, 'Amer. Journ. of Med. Sci.,' Jan., 1884. In the lower limb it may occur to the peronei tendons, and tendon of the posterior tibialis as well as to the conjoined tendon of the extensors of the leg attached to the patella and to that of the Sartorius muscle. Other tendons may, also, doubtless be dislocated.

Whenever dislocation takes place, it can be recognised by the starting of the tendon from its anatomical position, as well as by the pain suffered on putting the muscle into action—the muscle necessarily acting at a disadvantage. The tendon in most cases may be readily reduced, but the greatest difficulty will be experienced in keeping it in position; indeed, it is a question whether the sheath of a tendon when fairly ruptured will ever unite or repair, yet the attempt to obtain it should be made. In a case of dislocation of the peroneus longus tendon, the only treatment that gave permanent relief was its division, and, what is more, the foot was not visibly weakened by the operation. In 1869, I had under my care a woman, æt. 29, with a well-marked example of dislocation of the peroneus longus tendon. Some ten days before I saw her, when walking, she felt a sudden pain behind the external malleolus, which led her to think she had been struck with a stone. She was at once disabled and experienced severe pain in the part; and on rubbing her ankle at the time, she felt a cord in front of the bone, which slipped in on moving the foot. Since that time any movement of the ankle caused the same cord to appear. When I saw her, by giving the foot the slightest twist the tendon of the peroneus longus muscle could be readily displaced from its groove behind the external malleolus and made to appear upon the bone, where it could be rolled under the finger. Its reduction was effected by abducting the foot, but it was kept in its position with great difficulty. For this purpose the best means were a good pad of lint fixed over and behind the ankle by means of strapping. I saw her a month after the accident, when she could walk without pain or stiffness; the tendon seemed fixed in its place; but the bandage and pad were re-applied, and directions given to retain them for a month. I have likewise seen the tendon of the tibialis posticus displaced from behind the inner malleolus.

Of peroneus longus.

Dislocations of muscles are probably more rare than those of tendons, and if not, are less recognised. They may be suspected to have taken place where, after a rick or strain, pain is produced when the muscle is put into action and the pain is fixed to a spot; when this pain is relieved by relaxing the affected muscles and kneading the part with the hand when so relaxed; and when, moreover, there is no external evidence of a bruise to suggest rupture of muscle. These cases should be treated by manipulation after relaxing the muscles, the surgeon with a strong and firm pressure manipulating the part at the seat of pain; subsequently pressure should be applied, and the muscle kept at rest for a sufficient time to allow the injured part to heal.

Of muscles.

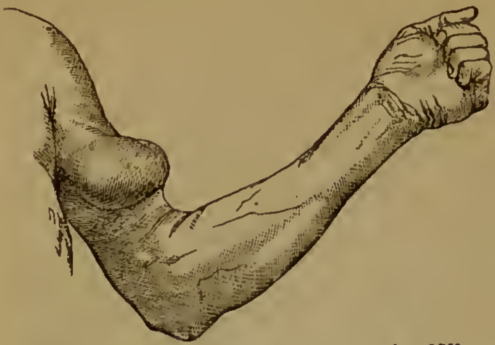
Rupture of Tendons.

This accident is more common than rupture of the body of a muscle, and a tendon usually gives way at its muscular or bony origin. It occurs chiefly in subjects past middle life. The long biceps tendon not rarely gives at its upper end, and, when it does, it imparts to the biceps muscle on contraction, a peculiar appearance; its inner or coracoid half contracting into a hard knot (Fig. 413), while its outer remains lax and but slightly altered. This swelling has been mistaken for tumour of the muscle of the arm. When the one tendon breaks, the other usually follows at a later date, thereby clearly indicating that they give way from some disease. In a case I treated in 1858 the two tendons gave way at the interval of four months, and the arm became black and blue after the accident. The tendo Achillis rarely snaps. The plantaris does occasionally, and when it does causes a peculiar dragging of the foot and eversion. In the

Rupture of tendons.

case of a man, æt. 27, which I saw a few hours after the accident, this symptom was so marked and peculiar as to make it quite pathognomonic. The rupture was caused by taking an upward step of two and a half feet into a vessel with a load on his back. The tendon gave way with a snap when in the act of raising the posterior part of the heel from the ground.

Fig. 413.



Ruptured long tendon of biceps. Drawing 37^{60}.

Rupture of tendon of biceps femoris.

I have likewise the notes of a case of rupture of the tendon of the *biceps femoris,* which took place in a boy, æt. 8, who, when hanging on behind a four-wheeled cab, had one of his legs entangled in the wheel. When admitted into Guy's directly after the accident, the tendon of the biceps femoris was made out to have been ruptured at its insertion into the fibula; there was a marked depression at this point, with ecchymosis; the limb was flexed and fixed on an outside splint, and a good recovery ensued, although there was some weakness of the muscles supplied by the external popliteal nerve, which had apparently been injured at the same time.

Of ligamentum patellæ.

Looking upon the ligamentum patellæ as a tendon, the following example of its rupture may be recorded. In 1867 I was called upon to treat a man, æt. 31, for an injury he had sustained to his right knee ten days previously, while attempting to save himself from falling backwards. The knee swelled after the accident and became acutely painful, and, when I saw him, the patella was drawn up for at least an inch, the ligament having been divided. I treated the case as for fractured patella, with a posterior splint, and employed pressure to bring the patella downwards, but I was unable to alter its position to any extent. The man recovered, however, with a useful limb.

Wounds of Tendons.

Wounds of tendons.

When tendons have been divided in incised wounds they separate, and their separated ends adhere to their sheaths, with the necessary consequence of impaired movements of the parts to which the tendon is attached. To avoid this, as a primary treatment of divided tendons, the tendons should always be sutured with silk or catgut, the muscle with which it is connected relaxed, and the wound dressed for quick union, the part being kept in position by means of a splint.

Case.

In June, 1883, a woman, æt. 34, had the extensor tendons of her ring and little fingers divided above the wrist. My dresser enlarged the wound lengthways, found the separated ends, and stitched them together with carbolised catgut. He then washed the wound with iodine water and dressed it with terebene oil. Good repair followed with movement of the fingers.

In June, 1883, a man, æt. 31, came under my care with a divided tendo Achillis from a broken water-jug. The ends of the divided tendon were separated for about two inches. My dresser, Mr. R. Knaggs, by my direction, exposed the tendon fully by a vertical incision, washed the wound with iodine water, and sutured the tendon with one central suture of carbolised catgut and two lateral sutures of kangaroo tendon. He then extended the foot and fixed it on a splint. The wound was dressed with terebene oil. Quick union followed, and excellent repair, without suppuration. In two months the man had a sound leg and strong tendon, with perfect movement of the foot.

This practice of stitching important tendons ought always to be adopted.

There is good reason to believe that a divided tendon may be successfully cut down upon several weeks after its division and its ends sutured with a good result.

Prognosis.

In wounds where muscles and tendons unite by granulation some stiffness and want of power in the part will remain for a long time, or even altogether. In healthy subjects it is remarkable how tendons at one time fixed subsequently free themselves from their surrounding attachments and become free again. This hope may always be held out to a patient who takes a gloomy view of his own prospects.

Inflammation of Muscle

Inflammation of muscle.

is a recognised affection, and occurs as a consequence of some strain or partial rupture of its fibres, as well as independently of any such cause. It is the more common as a result of injury, and is seen not seldom in the rectus abdominis as well as in the psoas muscle, in which as a cause of psoas abscess, I believe it to be not rare. As a result of septicæmia, it is frequently met with; and is found in every muscle, even the heart. It appears as a more or less acute affection of the muscle, and is accompanied by swelling, local pain, and constitutional disturbance; suppuration occurs in due time. The symptoms rarely come on directly after the injury, but probably after the lapse of several weeks, as a consequence of some want of repair in the injured part, and from the non-observance of the necessary rest which an injured muscle so much requires in the process of healing. When an abscess forms in a muscle the sooner it is opened the better, recovery readily following, even when the disease is in such a muscular organ as the tongue.

Symptoms.

In infants.

In sterno-mastoid.

Inflammation of muscle as an independent affection is generally chronic, and in adults is chiefly of syphilitic origin. In infants it is met with most commonly as an affection of the sterno-mastoid muscle; the body of the muscle wholly or in part appearing as an indurated mass. It is generally observed soon after birth, and may at times be traced to some injury sustained at that time. I have seen it in the offspring of syphilitic parents, but more frequently when no such history could be obtained. In fifteen consecutive cases a syphilitic history was obtained only in one. These cases rarely if ever suppurate in infants, but, under the use of warm fomentations and some simple tonic, such as cod-liver-oil, proceed to a natural recovery. I have never seen a case fail to recover by these means.

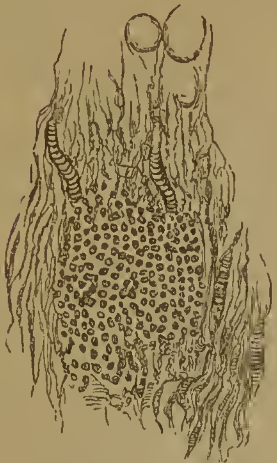
Rarely suppurate.

Treatment.

In the *early* period of the disease the inflammatory product is cellular; in the *later* fibrous. These points are seen in the drawings 414 and 414*a*, which have been kindly made for me by Dr. Goodhart. They were taken from a patient of Dr. F. Taylor's, æt. 5 weeks, who looked healthy, but had had "snuffles," slight fissuring of the anus, and superficial ulceration of the scrotum. There was no history or other evidence of syphilis in the parents. The child died from atelectasis. The tumour in the *left* muscle was only noticed in the fifth week after birth, and the *right* muscle was never noticed to be diseased. The case is reported in the 'Path. Soc. Trans.,' 1875, vol. xxvi.

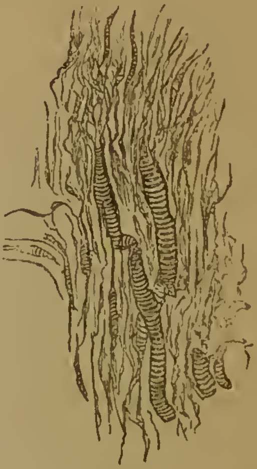
The student should remember that this affection appears as a simple induration of the muscle, and is, therefore, unlike any glandular or other affection.

FIG. 414.



Showing the early or cellular stage from the right muscle.

FIG. 414A.



The late or fibrous stage from the left muscle.

In adults mostly syphilitic.

Chronic inflammation of the sterno-mastoid is likewise met with in adults, and, I believe, chiefly as a consequence of syphilitic disease. It attacks the muscles in the same way as it does others, such as those of the tongue, the extensor quadriceps of the thigh, the triceps of the arm, the temporal, masseter, or other muscles, the muscle or muscles becoming infiltrated more or less diffusely with the well-known syphilitic inflammatory products. These tumours, when their nature is recognised and right treatment is employed, can be re-absorbed; but if neglected and left alone, after attaining their full size, which is rarely great, they break up and suppurate, giving rise to deep-seated abscesses, which, when they have discharged externally, leave deep, irregular, excavated sores. In the tongue they simulate closely cancerous sores; many of the cases of supposed cured cancer of the tongue being, doubtless, of this origin. In other parts, they have much the aspect of the deep cellular membranous ulcers which have been already described. As a part of syphilis, they always appear late in its course, and remote from the primary inoculation. When they appear in the adult, in the sterno-mastoid muscle, they more frequently attack its sternal end than its body.

Gummatous.

After the disease has ceased, atrophy of the affected muscle is a common consequence. Contraction occasionally follows, though I have never seen it. MM. Ricord and Notta have, however, recorded examples.

Atrophy may follow.

Recognising the syphilitic nature of this affection, the treatment should be conducted on the usual principles; large doses of the iodide of potassium, say fifteen to thirty grains, may be given three times a day with advantage; not in such full doses at first, but by gradual increase from one to five grains. Mercury may also be given, the mercurial suppository once or twice a day being the best form. In the chapter on syphilis this practice will be found described in detail.

Atrophy of Muscle.

Atrophy of muscle.

The Surgeon can see this under a great variety of circumstances. He is the most familiar with it as a consequence of want of use in disease of the joints, or any other affection in which the limb is kept at rest; and under these circumstances the muscles simply waste; they undergo no other change in structure, and are capable of complete restoration on re-assuming their normal action.

From infantile paralysis.

In a large number of cases of infantile paralysis, the same thing may also be said, for under the stimulus of galvanism or the continuous current, persevered in for many months, the thinnest limbs plump up, and the feeblest muscles become capable of performing the work for which they were intended. Indeed, in these cases where deformity does not complicate the case a good result may be looked for.

Progressive muscular atrophy.

After fevers, lead poisoning, rheumatism, scrivener's palsy, and alcoholism, the muscles may undergo genuine degeneration, either granular, fatty, or waxy, and according to Lockhart Clarke "there is another form of this malady, which is known by the name of *progressive muscular atrophy* (Cruveilhier), *atrophie musculaire graisseuse progressive* (Duchenne), and *wasting palsy*. This curious disease differs in several respects from the other atrophies. It is always chronic, but of uncertain duration, is frequently hereditary, capricious or irregular in its invasion, prone to spread from one part to another, or become general, and thus go on to a fatal termination. The affected muscles suffer different degrees of wasting, and assume a variety of aspects. Even in the same muscle bundles in different stages of atrophy and degeneration may be found at the side of others that have retained their normal state. When the wasting is extreme in all the bundles, a long muscle may be reduced to a mere fibrous and cylindrical cord, or to a kind of tendon, and a flat muscle may be reduced in the same manner to a kind of membrane. In some instances the atrophy may be *simple*, that is, the muscular tissue may be wasted to a considerable degree without any granular or fatty degeneration; but generally one or both of these alterations of structure are found to exist to a greater or less extent. The muscle also changes and varies in colour, according to the nature and degree of the atrophy. It is paler than natural; occasionally it is quite colourless, like the flesh of fish, or it may have a faint yellow or ochreous tint. Its consistence for the most part is increased in consequence of the increase in the interfibrillar connective tissue. When examined under the microscope the affected muscles may be seen to have lost, to a variable extent and degree, or even entirely, the appearance of transverse and longitudinal striation, while in a corresponding proportion the sarcous or muscular element is transformed into granules, which in some instances are too fine to be distinguished as

Pathology.

separate particles. The granules are soluble in acetic acid. In this odd affection the granular, fatty, and waxy degenerations are found side by side" ('Holmes's Syst.,' 3rd ed., vol. ii, p. 163).

Symptoms.

This disease is said to appear more commonly in the hand and right upper extremity, progressing upwards to the trunk, and then over it to the lower extremities. It rarely commences in the lower limbs. It begins with loss of power in the part, this loss gradually increasing, but rarely with any loss of sensation. Want of muscular co-ordination soon appears, as well as awkwardness in the patient's movements, and cramps, twitches, and fibrillary tremors take place, occasionally with pain or some cutaneous anæsthesia. Cruveilhier believed that atrophy of the motor nerves was the starting-point of this disease; but this theory is not now entertained; Lockhart Clarke says, "In 1861 I discovered in the spinal cord removed from a well-marked case of this disease, numerous lesions of the grey substance, consisting chiefly of areas of what I call granular and fluid disintegration; and I have seen the same in other cases since." This view is taught by Trousseau, Duchenne, Meryon, Roberts, Cohn, and others.

This disease is generally hereditary, more common in males than females, and is excited by excessive muscular exertion, cold, and damp, as well as by injuries or disease of the spine, syphilitic or otherwise.

Treatment.

TREATMENT.—Removal of the cause is the primary object, and when syphilis is suspected, special treatment should be employed. Tonics are always of use, and arsenic in Dr. Meryon's hands has met with good success; "but of all remedies hitherto employed galvanism is undoubtedly the most useful when applied to the affected muscles;" while Clarke states, that setons and blisters to the spine may be employed in the early stage.

Muscular degeneration with hypertrophy.

Degeneration of muscles with apparent hypertrophy, called Duchenne's disease, after its first describer in 1858, is a strange affection which attacks children, but continues to affect them for many years of their youth. I have grouped it amongst the affections of the muscles, but the observations of Dr. L. Clarke (' Med.-Chir. Trans.,' vol. lvii, 1874) clearly places it amongst the neuroses. It begins with weakness of the lower limbs which is lasting, and passes on to a progressive enlargement of the gastrocnemii, then of the glutei and lumbar muscles, and occasionally of all the muscles. These feel firm and elastic, and hard on contraction. After a variable period, at times years, the paralysis gradually increases and becomes more general. "The patient is no longer able to stand upright, the upper extremities become affected, the enlarged muscles rapidly decrease in volume, and the limbs and trunk become atrophied *en masse.* In this state the patient may exist for a considerable time, but he ultimately dies from intercurrent disease. Many of the children affected with this singular disorder have dull intellects, and are more or less idiotic." (Clarke.) Pathologically, great hypertrophy of the connective tissue of the muscle is to be found, the fibres themselves show finer striæ and are transparent, and large collections of fat-cells also exist. Neither medically nor surgically does any treatment seem to be of benefit.

Writer's cramp.

Writer's Cramp,

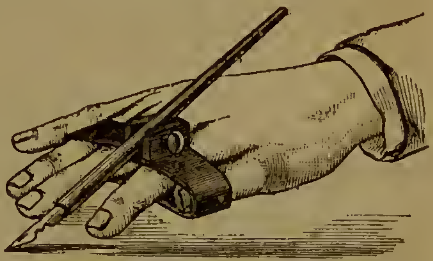
or scrivener's palsy, is a good example of what Duchenne has called "functional impotence," and it is doubtless due to over-use or exhaustion of the muscles employed. It begins as an aching of the hand after prolonged writing, with diminished facility in the act. After a time the pen is held in odd ways and with unusual tightness, but in spite of this it often falls from the hand. The whole forearm or arm soon shares in the trouble, and the difficulty in forming letters rapidly increases; tremors of the hand at times occur. At last the handwriting becomes illegible, or the patient loses all power even of making his mark. With these local symptoms there is often severe headache, or backache, and at times great mental distress.

In the majority of cases the inability to write is the sole trouble, but in many there is equal difficulty in adapting the muscles of the hand to the performance of any delicate action.

The affection is to be treated by rest, as guaranteed by a splint, and later on, when pain has passed, by gentle galvanic stimulation.

As a help to sufferers, the instrument figured below (Fig. 415), and suggested by Nussbaum, of Munich, seems of use; the eminence of its introducer is a guarantee of its value.

Fig. 415.



Nussbaum instrument for writer's cramp.

It is framed upon the opinion that, whatever the site of the malady, there is always spastic contraction of the flexors and adductors, with a weak condition of the extensors and abductors. With the bracelet put on as seen in the figure, these last muscles are strongly put into use, since the instrument can be worked only by abduction of the thumb and the extension of the digital muscles. The patient may write with the instrument as much as he likes. It is sold by Krohne.

Tumours in Muscle.

Tumours of muscle.

These are of rare occurrence, and always of a serious nature. They are mostly of the fibrous or fibro-cartilaginous kind. In 1866 I excised one of two years' growth from the fleshy portion of the external oblique muscle of a woman æt. 31 ('Path. Soc. Trans.,' vol. xviii). The tumour separated the fibres of the muscle which it infiltrated, and, microscopically, it had all the elements of the fibro-plastic tumours. It returned within the year, and when I last saw the patient, in 1869, there was a second growth the size of a cocoa-nut occupying the place of the original tumour. In 1868, with Dr. Burchell, of Kingsland, I removed from the abdominal muscles of a woman, æt. 33, a myxomatous tumour, eight or nine inches in diameter, of two years' growth.

Cancerous growths.

Cancerous tumours may originate in, but more frequently infiltrate, muscles as secondary growths or by extension from other parts. Surgeons see them in the pectoral muscles in acute or neglected cases of cancer of the breast; in the periosteal cancer of bone, as well as in other parts. In the tongue and lip they may be regarded as new growths.

Hydatids.

Hydatids, likewise, are found in muscles as in every other tissue, as painless, tense, globular, swellings. So also is that curious nematode worm the *Trichina spiralis*, which, in man, seems to be taken into the

Trichina.

body through eating the insufficiently cooked flesh of animals infested with them, particularly that of pigs.

"Trichinæ, as ordinarily observed in the human muscle, present the form of spirally coiled worms in the interior of small, globular, or lemon-shaped cysts, which latter appear as minute specks scarcely visible to the naked eye. These specks sometimes resemble little particles of lime, and are more or less calcareous externally, according to the degree of degeneration which their walls have undergone; these cysts are not, however, essential."—*Cobbold.*

Symptoms of trichiniasis.

When these worms are present in large numbers in the body they give rise to a disease known as trichiniasis, which is most fatal. Drs. Boehler and Königsdöffer, of Central Saxony, who first saw this disease according to Leuchart who described it, state that "the affection began with a sense of prostration, attended with extreme painfulness of the limbs; and after these symptoms had lasted several days, an enormous swelling of the face very suddenly supervened. The pain occasioned by this swelling, and the fever, troubled the patients night and day. In serious cases the patients could not voluntarily extend their limbs, nor at any time could they do so without pain; they lay mostly with their arms and legs half bent—heavily, as it were, and almost motionless, like logs. Afterwards, in the more serious cases, during the second and third week an extremely painful and general swelling of the body took place;" a large proportion of the cases died. Dr. Thudichum has given an able report on this subject in the 'Medical Officer's Report' to the Privy Council, 1864.

Vascular tumours.

Vascular tumours of muscle have been made the subject of a special paper by Mr. C. de Morgan ('Brit. and For. Med.-Chir. Rev.,' 1864), and Mr. Teevan has published an able paper on tumours in muscle in the same Review for 1874. These, however, are very rare. The vascular tumours of erectile tissue attack a muscle either as a diffused or encapsuled growth, or as tumours having the appearance of varicose veins around the muscle. They are chiefly though not always congenital, and are generally found in the lower extremities. They have no definite clinical history beyond their gradual and painless increase. My colleague, Mr. Howse, in 1872, excised such a non-encapsuled growth from the biceps muscle of the thigh of a woman, æt. 23, which was made up of erectile tissue and highly vascular, and had been growing for eight years. He excised all the muscle that was involved, but left its tendon. A good recovery ensued, with free movement of the limb.

Ossification of muscle.

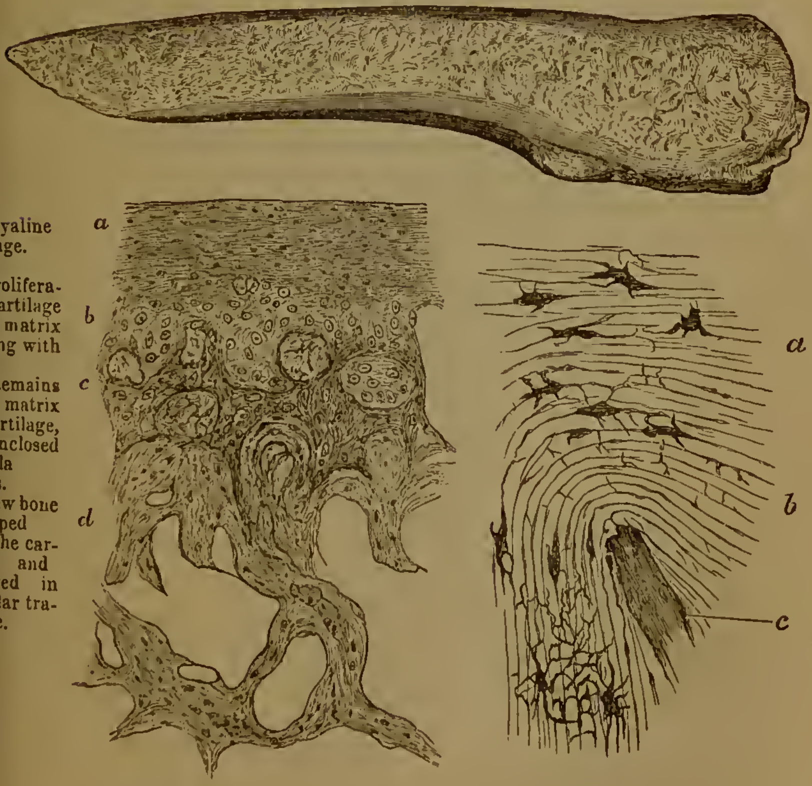
Ossification of muscle (myositis ossificans) is a condition which must be recognised. At the College of Surgeons and St. George's Hospital preparations exist which illustrate how the muscles of the back may become plates of bone, and the pelvis, ribs, and scapulæ the seat of bony outgrowths. In a smaller way the "drill bone" of the Prussian soldier; a plate of bone in the deltoid muscle; and, in this country, the "rider's bone" in the origin of the adductor longus muscle of the thigh, are illustrations.

Some years ago one of my colleagues at Guy's excised a piece of bone from the body of the deltoid muscle, an inch long, the growth of some years.

The rider's bone.

What has been described as *the rider's bone* is probably at first an inflammatory infiltration, and subsequently an ossification, of the tendon of the pelvic origin of the adductor longus or magnus muscle. I had such a case under observation in the person of a medical friend, æt. 44, who, while hunting in 1869, made a violent effort to grip his horse when about to make a long jump. The effort was not attended with any pain, but was followed by much ecchymosis, extending down to the knee, and loss of power in the muscles of the part. When these symptoms had subsided a dense induration was felt in the pubic origin of the right adductor longus muscle, which was painful on manipulation. As time passed this induration not only lasted, but became more dense, and when I first saw him, about three months after the accident, it was clearly in the sheath of the adductor longus, and moved with it. It grew somewhat during two years, and, when the tendon was rigid, it appeared as an outgrowth from the pubis corresponding to the origin of the adductor longus, of about two inches in length. When the muscle relaxed it was clearly only in the tendon, and had no bony origin. At the present time this gentleman can take his exercise as usual. There is a distinct grating to be heard and felt on moving the tumour, which has not grown for the last three years. The history of the case is identical with that given by Birkett ('Guy's Hosp. Rep.,' 1868). Billroth has also described this affection. Example.

FIG. 416.



a. Hyaline artilage.

b. Prolifera-ing cartilage ith a matrix taining with osin.

c. Remains f old matrix f cartilage, ith enclosed edulla paces.

d. New bone eveloped om the car-ilage and rranged in regular tra-eculæ.

a. Lacunæ and canaliculi.

b. Lamellæ.

c. Haversian artery.

Rider's bone seen in section with its microscopical appearance.

Fig. 416 represents a section of such a bone, kindly given to me by my friend Mr. Gowlland, with a microscopical drawing of the same made by my colleague Mr. C. Symonds.

The bone is irregularly conical in shape, and is three inches and a half in length. The base is somewhat flattened, and measures three quarters of an inch across.

The section shows an outer layer of compact bone, which, traced towards the bone, blends with an irregular bony and cartilaginous mass. Many trabeculæ divide the rest of the surface into a cancellous tissue of rather dense character.

Microscopical sections were made from the base to show the mode of growth, and on reference to the figure it will be seen that a thick layer (only half is represented in the drawing) of hyaline cartilage forms the surface. This contains more cells than that ordinarily found in normal tissue. The deeper surface shows proliferation of cells and an alteration of the matrix. Irregular cavities result as in normal ossification, though less regularly, and upon the old calcified cartilage the new bone is laid down as in fœtal bone. As in normal ossification also, all the new material takes up the eosin, while the cartilage stains with logwood, a chemical difference apparently the result of growth.

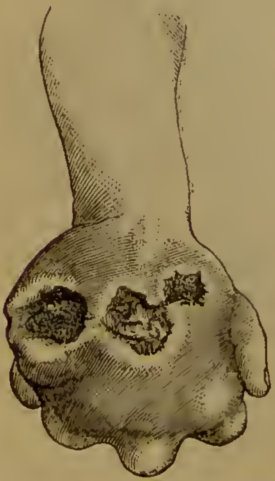
The small figure, sketched from a piece that was ground down in the dry state, shows the lacunæ and canaliculi as in true bone. The lamellæ were irregularly arranged, and the canaliculi and lacunæ large, with a less perfect communication than in normal bone.—CHARTERS J. SYMONDS.

Tumours of Tendon.

Tumours of tendon.

Besides ganglion, other tumours are found connected with tendon, and of these, the cartilaginous and fibrous are the most common. I removed from the long extensor tendon of the middle finger of a boy, æt. 14, a fine example of the former. Some are said to begin as ganglion, and subsequently to consolidate. I have seen one composed of bone and cartilage of two years' growth removed from the extensor tendon of the hand, which was said to have such an origin. Tumours with tendons passing through them are not rare, and on two occasions I have had to amputate the hand of a child for a cancerous tumour occupying its palm, through which all the flexor tendons passed (Fig. 416A). In 1867 I removed from a boy, æt. 3½, a congenital tumour the size of a walnut, which evidently grew from the theca of the tendon of the long extensor muscle of the thumb. The tendon passed through the tumour which surrounded it. Dr. Moxon examined the growth with myself, which was clearly composed of fat or condensed fibro-cellular tissue.

FIG. 416A



Cancerous tumour of the hand. Dorsal aspect.

The majority of tumours connected with tendons, however, are of the nature of ganglion more or less indurated.

Inflammation of Tendons.

Inflammation of tendons.

As an acute affection this is most serious, and gives rise to severe local and constitutional symptoms. It is met with as a consequence of a severe strain or laceration of tendon, or of some punctured or other wound involving the sheath. It may begin in one toe or finger, and spread upwards to the palm, and so on to other tendons, and even up the forearm. The local symptoms are pain, with the external evidences of inflammation, heat, redness, and swelling; the swelling being deep-seated, while the pain soon extends up the arm beyond the seat of mischief. The constitutional symptoms are those of more or less severe pyrexia.

If surgical interference is not brought to bear upon the case at an early period suppuration must soon appear with symptoms of throbbing and aggravated local distress, as well as the constitutional symptoms, rigors, excitement, and depression; inflammation of the absorbents and their glands will probably complicate the case.

Under still more neglect, sloughing of the affected tendons and diffused inflammation, with suppuration of all the parts involved in the disease will ensue. A finger, hand, or forearm, may be jeopardised or sacrificed, if the inflammation be very active or the treatment with which it is met insufficient.

Absorbent inflammation and blood poisoning (septicæmia) are common accompaniments of this affection.

Treatment.

Treatment.—This affection is very amenable to surgical control, and a free incision into the swollen part is the best means of arresting its progress by relieving tension. The operation not only relieves pain, which is caused by the tension of the fibrous tissues from the effusion beneath, but arrests the progress of the affection by preventing the inflammatory effusion burrowing up the theca of the tendon.

Relieve tension.

Necessity of early incision.

For these objects a clean cut down to the theca should be made as soon as hardness of the parts, with external evidence of inflammation, appears. If pus escape the practice must be good, but, if serum only, the operation will tend to arrest the progress of the affection at its onset, prevent the formation of pus, and probably check the disease. The incision should be *vertical* over the middle line of the finger and the centre of the tendon, no vessel or nerve of importance being there in the way.

When suppuration exists the Surgeon must follow up with his lancet every line of inflammation and suppuration, for in no tissue does more harm ensue from retained fluids than in the fibrous.

In the very earliest stage of the inflammation warm fomentations and possibly leeching may be beneficial. Elevation of the limb, the hand being higher than the elbow, and the elbow than the shoulder, undoubtedly relieves pain. A saline purgative is often serviceable. But the Surgeon must not lose time by such temporising means; for tension of the part means its death by strangulation, if not mechanically relieved, and medicines have no material influence upon the affection. When suppuration appears, tonics and liberal diet are required, as well as stimulants carefully adjusted to the necessities of the case. Sedatives are always wanted in some one of their forms. Morphia acts the most rapidly in quarter- or half-grain doses given subcutaneously. Water dressing or poultices should be applied. In very severe cases, when the powers of life are failing, amputation may be justifiable, more particularly when the

Occlusion of main artery for arrest of inflammation.

prospects are small of giving a useful hand or arm. For the arrest of diffused inflammation in the hand and arm the occlusion of the main artery of the limb has been suggested. Moore and Maunder have both adopted it in the upper extremity, with enough success to justify the practice. Bleeding is apt to take place at times during the progress of the sloughing of the tendon, and, if recurrent, such a complication is likely to induce the Surgeon to perform some operative act for its control upon the main vessel of the extremity. Before doing this, however, he should always remove any sloughing tendon, as I have known hæmorrhage, even of a severe kind, to be kept up by the presence of a sloughing tendon in a part, and to have been arrested by its removal.

Chronic Inflammation of Tendons.

Chronic inflammation of tendons.

The thecæ of the tendons of the extensors of the thumb, of the tendo Achillis, and the long tendon of the biceps, as of other muscles, are liable to inflame, and this action is attended by pain and weakness on moving the muscles, and at times by swelling. More frequently, however, the affection will show itself by a peculiar crackling sensation, which may be felt on grasping the part when the muscles are in motion. This crepitation, when it has followed an injury, has more than once been mistaken for that of fracture; yet it is distinct, and when once felt ought to be recognised. The affection is readily cured by rest of the affected muscles, through the application of splints and by counter-irritation by means of one or more blisters. The inflammation rarely goes on to suppuration unless neglected.

AFFECTIONS OF BURSÆ MUCOSÆ, SYNOVIAL CYSTS, GANGLION, ETC.

Definition.

Simple bursæ are protective synovial sacs found in the subcutaneous tissue, wherever pressure or friction is persistently present.

Synovial bursæ are of the same kind, and are formed in the same way, although situated between bone and muscle, tendon and bone, or between muscles; while some synovial bursæ are really *synovial herniæ*, or pouchings of an over-distended membrane of a joint into the connective tissue between the muscles. *A ganglion* is a bursal swelling directly connected with the sheath of a tendon; it may either involve one tendon and be *local* or many and be *diffused.*

When a bursa (simple or synovial) has an established anatomical position it is called normal, and when it is a purely pathological production, accidental. Any of these bursæ are liable to inflame, suppurate, or consolidate.

Simple Bursæ.

The subcutaneous bursa over the patella or its ligament is more commonly enlarged than any other, and when it is so is known as the "housemaid's knee." When it acutely inflames, suppuration rapidly takes place, and if an external outlet for the pus is not soon established diffused suppuration around the knee and over the patella follows. Indeed, most of the cases of diffused suppuration around the knee have their origin in "bursitis."

Bursæ liable to inflammation.

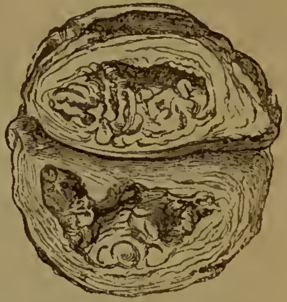
When the inflammation is less acute, and shows itself by serous effusion into the bursa, it may give rise to local pain on pressure and a peculiar crepitation, this crepitation often existing before any perceptible enlargement of the bursa has taken place.

Chronic inflammation of bursæ.

Symptoms.

In the more advanced stage, when the effusion has increased, an encysted fluctuating swelling will have formed, which may be tense or flaccid, the degree of tension of the bursa turning entirely upon the rapidity of the effusion. In more chronic examples the bursa will appear harder, firmer, and less distinctly fluctuating, while in very neglected or chronic cases it may have so consolidated as to appear as a solid tumour, although the tumour will contain on section some cavity in its centre; the mass appearing to be made up of concentric laminæ of organised lymph (Fig. 417). In exceptional cases, however, the bursa may have completely consolidated. These bursæ, as a rule, contain simple serum, although at times the serum is blood-stained, while in other cases rice-like bodies (organised fibrin) or pedunculated fringe-like outgrowths like loose cartilages exist. When injured these bursæ may become filled with blood—their contents being grumous or like coffee-grounds (hæmatocele). Bands of lymph cross the sac at times, but more frequently they line it in regular, onion-like layers. In neglected cases this fibrin may die and slough away, the bursa being cast out as a whole, as in an ordinary cellular membranous ulcer, and in the case from which Fig. 417A was taken. In syphilitic subjects, this result is not unfrequent.

FIG. 417.

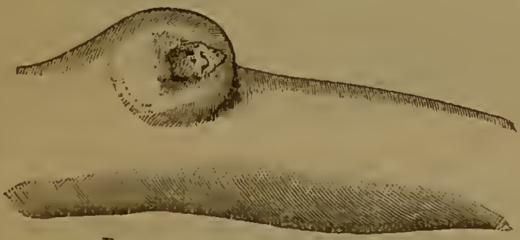


Semi-solid bursa, laid open. (Guy's Museum.)

Subcutaneous rupture.

On the other hand, a bursa may increase by effusion, and by some external cause rupture subcutaneously or externally, and thereby undergo a cure. In 1870 I had a case of the former kind under my care in a man, æt. 60, who had a bursa the size of a fist over his patella, which ruptured on kneeling. When I saw him the cellular tissue about the knee was infiltrated with serum which was subsequently absorbed, and the bursa did not reappear.

FIG. 417A.



Bursa sloughing from over patella.

Other seats of bursæ

What has been described as taking place in the bursa over the patella may occur in other parts, and more particularly over the olecranon process, where an enlargement of the bursa goes by the name of the "miner's elbow." I have, however, seen them over the acromion process in men who carry timber; over the tendon of the extensor quadriceps muscle of the thigh in a woman who habitually started her sewing machine with the knee; over the tuberosity of the ischium in Spitalfields weavers ("weavers bottom"), and in Thames lightermen; over the dorsum of the foot in extreme cases of talipes equino-varus when the children walked upon the part; over the external malleolus in tailors; over the malleoli and also the instep from the pressure of a boot; over the great trochanter of the femur in a soldier from pressure caused by sleeping on a board; and last, but not least, over the ball of the great toe in cases of "bunion," and in the sole of the foot over the heads of the metatarsal bones in men who walk much with short shoes, or with some who have contraction of the extensor tendons of the toes.

Bursæ will, however, enlarge or form wherever there is pressure, the enlargement being in a measure compensatory to save deep tissues. Yet this rule does not hold good always, for I have seen more than one instance in which enlarged bursæ existed over the knuckles of the first phalangeal joint of the hands without any such cause.

Treatment.
Tapping.
Excision.
Injection.
Incision.
Removal of loose bodies.

TREATMENT.—In the early crepitating stage of effusion, the removal of all pressure and the application of a blister are, probably, sufficient to effect a cure, and, in more advanced stages, the repeated application of blisters is often sufficient to excite absorption of the effused fluid and recovery. When these means fail and the walls of the bursa are thin, the cavity may be tapped and the parietes of the cyst firmly pressed together by means of a pad and strapping. When the walls are indurated, this treatment is useless; but a cure may generally be effected by the introduction of a seton which should be kept in till suppuration is freely established. In more solid cysts, none of these means are of use, and excision is the only sound practice, the Surgeon making his incision over the outer border of the bursa in order that the cicatrix may be out of harm's way. In some few instances where tapping has proved ineffectual, the cyst may be injected with thirty or more drops of the compound tincture of iodine in a drachm of water as in hydrocele. When blood has been effused into the bursa from a blow, as indicated by its sudden increase, a free incision into the cyst and the evacuation of the clots may be expected to be followed by a recovery; but this should only be done when its absorption does not take place by natural processes. When loose or pedunculated bodies exist in a bursa and cause distress, they may be removed by means of a free incision through its walls.

Synovial Bursæ.

An enlargement of a synovial bursa is a far more serious affection than that which has been just described; as these bursæ are situated about tendons or muscles, the articular extremities of bones and joints, and in many instances, indeed, have direct communication with joints.

Deep bursa beneath deltoid.

There is a deep bursa beneath the deltoid muscle which, when inflamed, gives rise to swelling around the shoulder-joint, and pain and crepitation on movement, simulating shoulder-joint mischief; at times, too, this bursa communicates with the joint through the bicipital groove in which the biceps tendon plays. It may be distended with serous fluid or may contain loose bodies such as are found in other bursæ or ganglia. They should be dealt with cautiously on account of the possibility of their communicating with the joint. Hence, blistering and absolute rest of the arm are the best means to employ, the bursæ being opened only when obstinate, and when pouching exists in front of the deltoid tendon. From one of these bursæ on two occasions, I have evacuated within three months more than half a pint of bursal fluid, containing melon seed-like bodies, a recovery subsequently taking place. Such an operation should, however, be done only after grave consideration.

Inflammation of bursa beneath extensors of thigh. Differential diagnosis.

Another extensive bursa, situated beneath the *extensor muscles of the thigh*, is not infrequently the seat of acute or subacute inflammation, and such cases have been mistaken for inflammation of the knee-joint. The diagnosis ought not, however, to be difficult, for in the bursal enlargement, however great, the bulging of the cavity will seldom extend downwards beyond the upper border of the patella; and will not, as in joint disease, extend to either side of that bone or below it. Fluctuation, moreover, will only be felt above the joint and not obliquely through it. When the patient stands, the difference between the distension of the bursal and that of the synovial sac will be also at once manifested. With this enlargement, there may be some stiffness of the joint, but there will be always mobility. This bursa at times becomes the seat of suppuration, when the necessity of a correct diagnosis is more important on account of treatment. In all cases it is necessary to maintain rest, and the absorption of the fluid should be promoted by blisters. In obstinate cases when the bursa is very tense, the cavity may be tapped, and when it suppurates, freely opened; but neither of these operations should be undertaken without strong necessity. Suppurative inflammation of the bursa may extend to the joint with a fatal result. I have tapped such a bursa in a woman, æt. 35, and drawn off eight ounces of a thick, grumous-looking, semi-purulent fluid with success; in a second case, a woman, æt. 50, I made a free incision into the bursa, and evacuated many ounces of pus and blood, such as escapes from a hæmatocele; a good recovery took place.

Bursa beneath ligamentum patellæ.

The deep bursa between the ligamentum patellæ and the bone is very liable to inflame and enlarge, which gives rise to pain that is often mistaken for joint disease. The pain, however, is always local over the bursa and aggravated by the patient attempting to raise the extended leg. It is very troublesome, and when established, can only be treated successfully by means of blisters and rest with the leg on a posterior splint.

Bursa over the tuberosity of the os calcis.

The bursa situated over the upper part of the tuberosity of the os calcis, between the bone and the tendo Achillis, is sometimes inflamed, and gives rise to a marked projection in the part; it causes pain and lameness. It is to be cured by absolute rest (the foot and leg being fixed on a splint) and the application of blisters.

Bursæ beneath Poupart's ligament.

A bursa also naturally exists in connection with and beneath the tendon of the psoas muscle as it passes over the arch of the pelvis; this also may communicate with the hip-joint. When distended with fluid it will give rise to a swelling in the upper part of the thigh on the inner side of the femoral vessels, which will be soft and fluctuating, but will not receive any impulse on coughing, like a psoas abscess, for which it is apt to be mistaken.

Bursa between gluteus maximus and trochanter.

The bursa between the tendon of the gluteus maximus and trochanter may also inflame and suppurate, and, when it does, it gives rise to a troublesome and often dangerous affection. When suppuration takes place, an opening may be made, which should be free, but the thigh must be well fixed. When suppuration does not occur naturally the Surgeon should be in no hurry to open the bursa, but be satisfied to keep the limb at rest and blister the swelling.

In popliteal space.

Synovial bursæ in the popliteal space require a rather longer notice than the forms to which attention has already been directed, since they are, although common, sometimes difficult to diagnose and dangerous to treat. Their treatment, however, as a rule, is successful.

These bursæ may be divided in a clinical point of view into two classes—the *first,* including such as are connected with the sheaths of tendons or that encircle their insertion, and have no communication with the knee-joint; the *second,* those that directly or indirectly communicate with the joint and are either synovial herniæ pouching from it, or bursæ originating about the tendons and communicating with it.

That do not communicate with joint.

Among the *first* is the normal bursa which exists above the head of the fibula on the outer border of the politeal space between the insertion of the biceps muscle and the external lateral ligament; a *second,* which may be said to be on the outer border, although it has a somewhat more central position which separates the external lateral ligament from the tendon of the popliteus muscle; and a *third* on the *inner* side of the space which lies between the tendon of the semi-membranosus muscle and the inner tuberosity of the tibia—the whole of these bursæ occupying the *lower* half of the popliteal space.

In the *second* division, there is the smaller bursa which separates the outer head of the gastrocnemius muscle from the outer condyle of the femur, and the larger that normally exists between the internal condyle of the femur and the inner head of the gastrocnemius and semi-membranosus muscles, and which generally sends a process between these muscles, the smaller occasionally and the larger generally communicating with the knee-joint, both of these occupying the *upper* half of the popliteal space.

The larger bursa may have its origin on the inner side of the popliteal space, but as it grows, invariably encroaches on it and becomes central, and is more frequently enlarged than any of the other popliteal bursæ.

All these normal synovial bursæ may become enlarged under the influence of over or prolonged exertion or any sudden strain, the smaller ones increasing to the size of a walnut, and the larger to that of an orange. As they increase so they become central, and as they assume a central position difficulties in their diagnosis may be experienced. They may contain a thin, clear, or blood-stained serous fluid; a tenacious, synovial, or colloidal, apple-jelly-like material, and, in exceptional instances may have consolidated. I have, however, known this to occur but once. It is probable that the bursæ which have serous contents do not communicate with a joint, while those that have synovia do.

Diagnosis.—In a general way there ought not to be any difficulty in making these cases out, more particularly when the different positions in which they may appear are known, since their circumscribed and defined outline, their fluctuating feel and mobility when the leg is flexed, and their hardness and elasticity when fully stretched fairly characterise them. When, however, the swelling pulsates and a bruit is heard over the tumour, some difficulty in diagnosis may be felt, although I can hardly understand how such a case could be mistaken for an aneurism, as on a careful examination the bursal pulsatile swelling could not be emptied and refilled by the application and removal of

When pulsating.

pressure upon the afferent artery, as would an aneurism; neither would the pulsation be so distinct nor the bruit so clear; for both the pulsation and the bruit would have been simply communicated. The position of the bruit, moreover, would have a greater influence upon the symptoms in a case of bursa than in that of aneurism; for whereas in the latter, by *slightly* flexing the leg upon the thigh, the aneurism would become more defined, its pulsations more marked and under control, in bursæ the swelling would become more flaccid and less distinct. Extension makes the pulsation and the swelling to be more distinct in the case of bursæ, and less so in that of aneurism.

When communicating with joint.

With respect to the diagnosis of a synovial bursa which communicates with the knee and a true synovial hernia, I have not much to add beyond the fact, that in the former there may be no symptoms of knee-joint disease, whereas in the latter, there will to a certainty be chronic effusion into the joint, which probably will be part of an osteo-arthritic change.

When pressure upon the popliteal swelling causes it to diminish or disappear, while the joint itself enlarges and becomes fluctuant, or more so under the pressure, it is a fair inference that the joint and bursa communicate, although when these conditions do not exist, it would be wrong to infer the opposite, for the opening from a bursa is at times valvular and altered by position.

Treatment.

Treatment.—As an enlargement of these bursæ always follows excessive muscular action and strains, so by absolute rest of the limb as guaranteed by a splint and the application of repeated blisters, can the bulk of them be made to disappear. In obstinate examples of the first division of cases tapping may be resorted to, whereas in the second it should be undertaken only where other treatment has failed, and then with extreme care by means of the aspirator. In still more obstinate cases where the limb is rendered useless, a free incision may be made into the cysts, or they may be excised; but such desperate measures are only applicable in desperate cases.

The first division of cases may always be boldly dealt with, but the second should be treated with extreme caution.

Thus, in a case which was under my care some years ago, where by repeated blistering the tumour disappeared for a time only to recur, a Surgeon was induced to tap and subsequently incise the cyst, after which, acute suppuration of the part occurred, which in the end compelled amputation.

Bursa simulating tumour.

The case of solid bursa already alluded to occurred in my own practice. I mistook it for a tumour, having punctured it with a needle without obtaining any flow of fluid. It was in a man of middle age, had been growing for about ten years, was the size of a fist, filled the popliteal space, and was solid and moveable. I found that it was connected with the inner hamstring tendon only when making the attempt to remove it. On recognising its nature I took away a large portion of the mass down to its central cavity, which was the size of a nut, but I left the deeper part. Suppuration, however, subsequently attacked the knee-joint, and amputation became necessary. I am unable to point out how a correct diagnosis could be made in such a case as this, but the record of the fact that a solid bursa may exist in this locality, as well as the unfortunate result which accrued upon operation in my case may be of value. Holmes draws attention to a valuable paper by M. Foucher on this subject in the 'Archives Générales de Méd.,' 1856.

Synovial Cysts.

Synovial cysts.

In connection with this subject of synovial hernia it should be stated that at times these herniæ rupture, and the synovial fluid escapes into the connective tissue of the leg, forming a synovial cyst; and if Mr. Wormald was right when he taught that the thinnest point of the joint capsule was at the spot at which it partially encircles the tendon of the popliteus muscle, it is more than probable that it is at this spot that the fluid escapes.

The synovial cyst may occupy the popliteal space and upper part of the calf of the leg, or may be evident in the calf of the leg only, projecting most, as a rule, on the inner aspect of the leg, or may be perceptible only at the upper and inner part of the leg as a small defined swelling, not approaching within three or four inches of any part of the knee-joint. There need not of necessity be any communicable fluctuation between the cyst and the joint.

These cysts are generally found in joints that are the seats of osteoarthritis, and are curable. They should not be punctured or otherwise subjected to operation, unless there appear strong reasons for so doing, inasmuch as interference may lead to acute inflammation and suppuration of the knee-joint.

For this information I have to thank Mr. Morrant Baker, who has written a valuable paper on the subject in the 'St. Bartholomew's Hosp. Rep.,' 1877. It recalled to my recollection several cases which were doubtless of this affection, and which I did not understand.

Ganglion.

Ganglion.

Diffused.

This is met with in two forms, the one the more common as an encysted swelling connected with the sheath of a tendon; the second as a more diffused swelling, involving the theca of one or of many tendons, those of the wrist being the most commonly affected; and the flexors more frequently than the extensors. I have, however, seen it in the extensors of the toes, and on the dorsal aspect of the foot beneath the annular ligament of the ankle; but it may attack any tendon. Ganglion is always the result of strain or over-action of the tendons. The local ganglion always contains colloidal apple-jelly-like material, which is at times crystal-like in clearness, at others pinkish. In the diffused the fluid is more like synovia, containing loose bodies.

"The bursæ or ganglions which form about the sheaths of the tendons at the wrist appear to be the cystic transformations of the cells enclosed in the fringe-like processes of the synovial membrane of the sheaths . . . Sometimes they are distended with serous fluid; at other times their contents possess a gelatinous, or even a honey-like consistency, which constitute a form of meliceris. Under some circumstances free fibro-cartilaginous-like bodies, irregularly shaped, composed of a compact connective substance, form in considerable numbers, more especially in the ganglionic enlargement of the synovial bursa which surrounds the flexor tendons of the fingers at the wrist."—*Paget*, 'Surg. Path.'

Local.

The localised form of ganglion is more common on the dorsal aspect of the wrist than anywhere else, although not rarely it is connected with the flexor tendons, and appears as a globular or irregularly cystic, tense swelling of the part. At times it is very hard, at others fluctuating and soft. When of good size it may be translucent. Pressure upon it to any extent causes pain, severe pressure sickening pain, even fainting and vomiting. Those in the palm of the hand about the head of the metacarpal bones are the most painful. At times ganglion is painless, causing only some weakness of the wrist.

A large ganglion occasionally forms behind the external malleolus connected with the peronei tendons. It should be touched with care.

Symptoms of the diffused form.

The diffused or compound ganglion varies in its symptoms according to the number of tendons involved. When one only is affected it may appear as a deep-seated, fluctuating, irregular swelling in the course of the tendon, the amount of swelling and deformity depending entirely upon its size. The swelling, when many tendons are involved, will be diffused; but when the whole of the flexor tendons are implicated it will occupy both the palm of the hand and the forearm above the wrist. In the case illustrated in Fig. 418, taken from a woman, æt. 49, sent to me by Dr. Lovegrove, now of Hythe, all the flexor tendons were involved to an extreme degree. In such cases as these the foreign bodies, commonly called "melon-seed or rice-like" bodies, are usually present. They may frequently be made out to exist by the Surgeon when ascertaining the presence of fluctuation from above and below the annular ligament of the wrist by firm pressure alternately applied in this direction, the pressure exciting a peculiar rough scrooping sensation, caused by these loose bodies passing along the thecæ of the tendons beneath the ligament.

Melon-seed bodies.

Treatment.

Blisters.

Treatment.—The local ganglion when first formed, may often be cured by the application of a blister and by securing rest to the tendon by means of some splint; but when it has existed for some time, such treatment is useless. When it can be ruptured by pressure applied by grasping the flexed hand with both hands and by one thumb superposed upon the other over the ganglion, a cure may often be effected; firm pressure being subsequently kept up by means of a pad of lint and strapping. When this fails, the ganglion should be punctured subcutaneously by means of a spear-shaped needle or fine tenotomy knife, its contents squeezed out, and pressure applied by lint and strapping as before. When success does not follow this treatment, a silk seton may be introduced, the hand being kept quiet on a spint, but it should be removed so soon as suppuration has been established. This treatment should not be employed, however, until all minor means have failed, for it is occasionally followed by diffused inflammation of the theca of the tendon with all its dangers.

Rupture.

Puncture.

Seton.

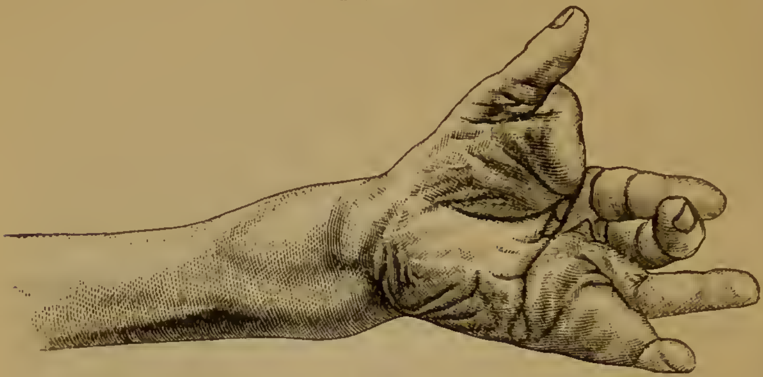
Of the diffused form.

The diffused or compound ganglion is dangerous to deal with; that is, any interference with it may be followed by severe inflammation of all thecæ involved, and thus limb and life be jeopardised. But this result is not common when proper precautions are taken to guard against it. The risk of such a thing should always, however, be laid before the patient by the Surgeon before any operation is arranged.

Incision.

The only effectual way of dealing with it is by incision. To do this, the Surgeon should for some five or six days before fix the hand and forearm upon a splint; he should then make a clean cut into the affected theca, free enough to allow of the ready escape of all the ganglion contents without any forcible manipulation. When many thecæ are involved, more than one incision is called for. The incision should always be made in a vertical direction over the tendons, and both above and below the annular ligament when the disease extends up the arm. After the operation the whole cavity should be well washed out with iodine water, and the wound dressed with terebene oil or iodoform gauze and powder. A splint should be kept on for a week, after which movement of the finger should be allowed, when the fear of diffused suppurative inflammation has passed away. In the severe example of the affection illustrated in Fig. 418, this practice was adopted with success, and in many others of a less severe character, I could record the same result. I have never had occasion to divide the annular ligament, as advised by Syme, in the 'Edinburgh Monthly Journ,' Oct., 1844.

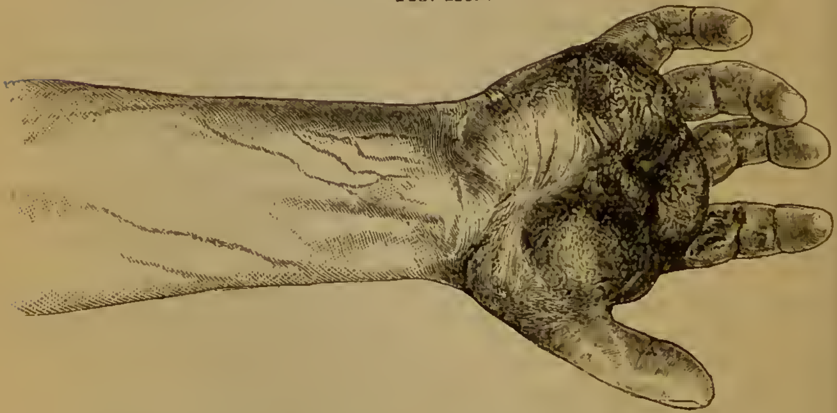
Fig. 418.



Ganglion involving all the flexor tendons of hand and wrist.

The case illustrated in Fig. 418A, was mistaken for this affection; it occurred in a man æt. 49, and had been of many years' duration. The swelling had the appearance and feel of the diffused ganglion with foreign bodies. Indeed, the sensation of the presence of foreign bodies was marked between the dorsal and palmar surface of the hand. The swelling was, however, entirely confined to the hand and did not extend upwards above the annular ligament ('Lancet,' 1884, p. 846). My friend Mr. H. Morris tells me that he has seen two cases of fatty tumour connected with the median nerve with clinical symptoms like those described.

Fig. 418A.



Lipoma situated beneath the flexor tendons of the hand simulating ganglion.

I operated upon it as for ganglion and to my surprise found the whole swelling was due to the presence of a diffused lipomatous tumour situated beneath the deep flexor tendons and completely surrounding them, dipping down between the bones to appear upon their dorsal region. I removed the mass with much difficulty after a tedious dissection, washed the whole palm out with iodine water and puffed into the wounds some powdered iodoform. I then fixed the hand upon a dorsal splint. Quick repair followed the operation without constitutional disturbance or suppuration. Within three weeks the man was well and returned home with a hand in no way impaired by the severe operation it had been subjected to. In this case the fact that the swelling had not extended above the annular ligament ought to have suggested that another cause than ganglion existed to explain the symptoms.

CHAPTER XXIX.

DEFORMITIES, CLUB-FOOT, AND ORTHOPÆDIC SURGERY.

Malformations.

Their varieties.

MALFORMATIONS remain to be considered, those of special parts having already received attention under other headings.

They may roughly be classed as being due either to *excess* or hypertrophy, or to *deficiency*.

Unnatural adhesions between parts is not rare, and mal-development in some odd way is occasionally met with.

Excess of development.

As examples of excess of development, supernumerary fingers or toes are the most common, the supernumerary digits being more or less well formed or rudimentary; appearing either as skin appendages (8, 9, Fig. 419) or being more like cleft phalanges, with common metarcarpal or metatarsal bones (2, 6, 7, Fig. 419). The thumb is very commonly cleft.

Thus, out of twenty cases of supernumerary fingers and toes consecutively noted, eight were of the thumb, and four of the fingers alone, three of the toes alone, and five of the fingers and toes together, the deformity being symmetrical in six of the cases. Occasionally supernumerary fingers or toes have perfect metatarsal or metacarpal bones, and more rarely the hand may be double. The late Jardine Murray, of Brighton, has recorded such a case ('Med.-Chir. Trans.,' vol. xlvi).

Hypertrophy of extremities is met with, either of whole limbs or parts of limbs. In drawing 10, Fig. 419, hypertrophy of one finger is shown, associated with deficiency of others, but hypertrophy is a type of the affection that is met with in practice, whether of a digit or extremity.

Treatment.

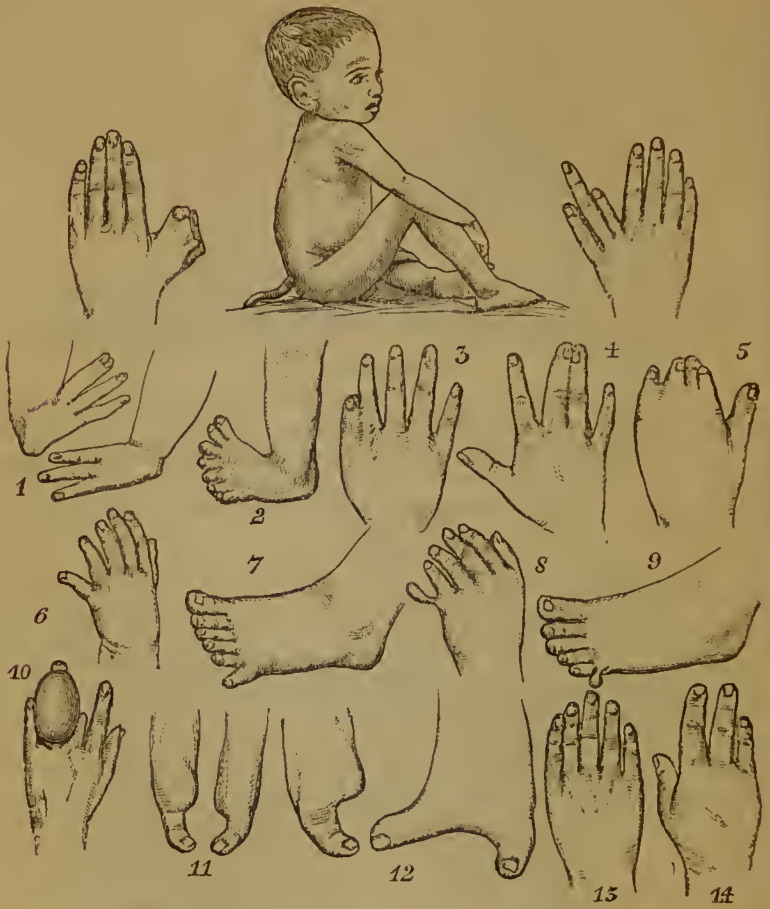
TREATMENT.—Rudimentary fingers and toes may be fearlessly excised when they appear as skin appendages, but, when they exist as bifid phalanges, great care is called for in their treatment on account of the frequency of there being a common joint to the two digits. Under these circumstances, the surgeon should carefully consider the question of amputation; and if he decide upon performing it, it will be wise to cut off the supernumerary digit some little distance from the joint, leaving a stump, which, as a rule, subsequently withers.

Hypertrophied extremities may be removed when they are sources of great inconvenience, but not otherwise.

Webbed digits.

Webbed fingers and toes are another common deformity. At times all the digits of one or both hands or feet are webbed, but more commonly only two are involved. Thus, I have seen the thumb and index-finger webbed in one case (No. 3, Fig. 419); the ring and middle fingers of both hands in another (No.4), and again in another the second and third toes of both feet. In one instance, the toes of one foot were webbed, and the fingers of the hands more or less truncated. In another, with webbed toes on both feet, there was a supernumerary right thumb. Indeed, where a disposition to deformities shows itself several varities of deformity may co-exist in the same subject.

Fig. 419.



Types of the different kinds of deformities of the hands and feet, with a drawing of a child with a caudal appendage, taken from life.

Treatment.

Treatment.—For the hand, when the fingers are well-formed, the Surgeon, if possible, should divide the web, but, under other circumstances, it is more prudent to leave it alone. When the web is very narrow there is nothing left but to divide it, but before doing so a good opening at the base of the cleft ought to be established to prevent the subsequent closure of the wound. This can be efficiently effected by means of the galvanic cautery or otherwise, and the subsequent introduction into the opening of a piece of aluminium wire, the wire being kept in till the wound has cicatrised and become as thoroughly established as an ear-ring hole. When this step of the operation has been effected, the cleft may be fearlessly divided.

When the web is broader and more material exists for the Surgeon's manipulation, the best plan to adopt is, to split the web transversely between the fingers, and to turn one flap of skin round one finger and the other flap round the second, stitching the edges of the flap to the skin of the finger.

Webbed toes need no surgical interference.

Deficiency of parts.

Absence of parts cannot surgically be remedied. In No. 13, Fig. 419, there was an absence of a thumb, but by way of compensation, an extra finger was given. In No. 14, the ring-finger was absent, but the index and middle were hypertrophied.

At other times, limbs are truncated as if from intra-uterine amputation, and, in rarer cases, bones and joints seem to be deficient. Thus, in a male subject I had under care some years ago the right arm was shortened as if amputated above the elbow, and the right lower extremity was represented by one short bone, with a foot that would have been called perfect if the little toe had not been absent.

These cases are mentioned, however, only as curiosities, and are beyond the pale of the Surgeon's art.

Mal-development.

Clawlike extremities as represented in Nos. 1, 11, and 12, Fig. 419, are very curious. No. 1 represents the hands of George N—, æt. 7 weeks, the third child of well-made parents, the other children being natural. Very little power existed in the claws, one finger alone being of use. The child in other respects was well-made and intelligent.

Nos. 11 and 12 were taken from Edward E—, æt. 4, one of eight children, three being boys and five girls, one brother having precisely the same deformity. The parents were well-made.

The hands in No. 11, had apparently but three metacarpal bones; the wrist and carpal joints being normal; the solitary digit had much power. The feet in No. 12, were still more oddly made. In both, the tarsal bones seemed to be natural, but on the right foot the metatarsal bones were confused together. The digits had good power. Nothing could be suggested for the patient's benefit.

Hereditary Nature of Deformities.

Heredity.

The hereditary nature of deformities is generally recognised, though in the history of such cases it is exceptional for such a tendency to be traced. When, however, it is made out it is, as a rule, remarkable. Deformities when inherited, are also generally of a like kind. Thus, deformities of the genital organs are passed on to succeeding generations, as is the disposition to harelip or webbed fingers, &c.

Generally of like kind.

Exceptions to law.

Exceptions to this rule are met with. Thus, in a family of twelve children, two out of four boys had harelip and fissured palate, and one out of eight girls had hypertrophy of the right lower extremity, with atrophy of the right great toe. The father of this family had a supernumerary little finger on one hand.

A female child, one of five, the other four being well made, had hypertrophy of the two inner toes of the left foot. They were at five weeks old as large as the toes of an adult, and as well made. The parents had no deformity, but the father's maternal grandfather had a double thumb.

A boy had a double thumb on one hand and a web between the second and third toes of both feet. His father had webbed toes.

These exceptions to the rule above given are, however, rare.

Examples of law

As illustrations of the rule, the following cases have been extracted from my note-books. A man had six perfect toes on each foot, and six perfect fingers on each hand. He was one of ten children, all of whom had the same kind of deformity. The parents of these children, were, however, well made.

A female child had left equino-varus. She was one of eight children, the other seven being well made. The parents had no such deformity, but the mother had two brothers and one sister so deformed, and her father had double talipes.

A man had scrotal hypospadiasis, and was one of nine children. Both his parents were well formed, and no history of deformity could be traced backwards. One of his sisters had harelip, while two of his brothers were deformed as he was, one having passed as a female till he was eighteen years of age. Two other brothers and three sisters were natural, but each of these brothers had a son a hypospadiac.

These cases are very striking.

Club-foot.

Paralytic distortions.

When paralysis takes place of a single muscle or of a group of muscles functionally associated, the opposing muscle or group losing antagonism, acts uncontrolled, and, as a consequence, contraction or deformity is liable to be produced, the deformities resulting from this class of cases being designated *paralytic distortions.*

Spasmodic distortions.

When a muscle or a group of muscles, from whatever cause, acts spasmodically with an active tonic contraction, or a slow and progressive one, quite irrespective of the will, or but slightly influenced by it, and in this way overcomes the opposing muscle or group of muscles, deformities may likewise be produced, such cases being called *spastic* or *spasmodic distortions.*

In the first class the degree of deformity depends much upon the degree of paralysis present, and in the second, on the amount of spasm or contracting force of the muscles involved. Some Surgeons would class all deformities in the first group, but this view is incorrect.

How produced.

Both may be *congenital* or *acquired.* In the congenital, greater changes take place in the conformation of the bones than in the acquired, these changes depending much upon the intensity of the muscular action, but more upon the period of life at which they commenced.

Little's views.

"It seems as if in congenital club-foot and analogous distortions a stimulus or irritant were present in the medulla spinalis, acting upon certain ganglionic cells there, which keeps the affected muscle in a state of chronic contraction, yet not sufficient to neutralise the stimulus of the will within the limits of movement permitted by the structural shortening of the member. Many non-congenital spastic contractions appear allied to the condition which prevails in some states of chorea, in which, when the will would permit or cause contraction or relaxation of a particular muscle, an involuntary influence excites contraction, interferes with and frustrates the voluntary effort. In more intense spasmodic contractions the will is entirely overpowered before structural shortening supervenes to effect the same end."—*Little.*

As an extra argument in favour of this view the fact may be adduced that club-foot often co-exists with other deformities, such as spina bifida and club-hand, &c. "Congenital and non-congenital club-foot spring from analogous causes."

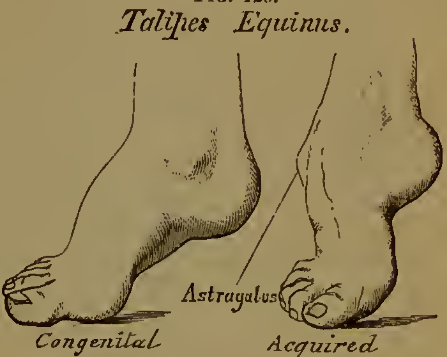
When these muscular contractions are powerful enough or continue long enough to alter the natural position of a part, deformity is said to exist, and according to its seat or form a special name is given to it.

To Stromeyer abroad as well as to Little in this country we are chiefly indebted for most of our knowledge on this matter, although in more recent times Tamplin, Lonsdale, W. Adams, Brodhurst, and others, have added much to the subject.

Stromeyer, however, in 1831, only followed Delpech in 1828, this great Surgeon, following a greater — John Hunter — who in 1794 established the principle of subcutaneous surgery, when he divided injuries to sound parts into two divisions, and established this principle, that "The injuries of the first division, in which the parts do not communicate externally, seldom inflame, while those of the second commonly both inflame and suppurate."

Club-foot may be divided into four typical forms:

FIG. 420.

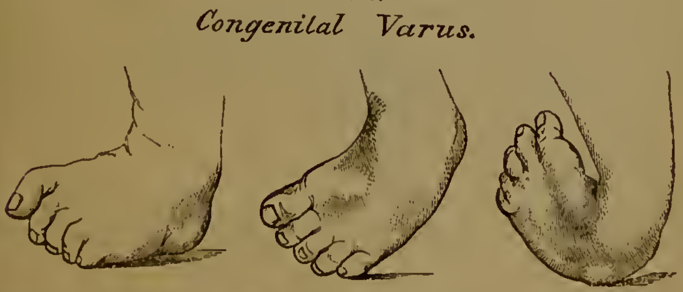


Club-foot. Its forms.

Talipes equinus, in which the heel is simply drawn up by the contraction of the muscles of the calf (Fig. 420).

Talipes varus, in which the foot is drawn inwards to different degrees (Fig. 421).

FIG. 421.



Three grades of severity.

Talipes valgus, in which the foot is turned out (Fig. 422).

And talipes calcaneus, in which the foot is drawn up and the heel depressed (Fig. 423).

Combinations.

Combinations of these forms are commonly seen; thus, we have *T. equino-varus,* when the foot is turned *in* and heel drawn up (Fig. 421A); *T. equino-valgus,* when the foot is turned *out* and the heel drawn up; *T. calcaneo-varus* and *calcaneo-valgus* being terms applied when the heel is depressed and foot turned in or out.

Talipes varus is the usual congenital form, but any may exist, talipes equinus and equino-varus and valgus being the more common acquired forms.

In *valgus,* the peronei muscles are chiefly involved; in *varus,* the adductors, particularly the two tibials; in *equinus,* there is contraction of the muscles of the calf through the tendo Achillis; and in *calcaneus,* paralysis of the same group.

Often hereditary.

Club-foot is often hereditary, and more prone to attack the male branches of a family than the female, and in this respect seems to follow the ordinary law of all deformities. In a case under my care of talipes varus the child's father, grandfather, and great grandfather, on the father's side, had congenital talipes, while none of the female branches of the respective families were deformed.

Degrees of severity.

"It is convenient, for practical purposes, to divide congenital club-foot into three degrees of severity: the *slightest,* that in which the position of the front of the foot, when inverted, is such that the angle formed by it with the inside of the leg is greater than a right angle, and in which the contraction is so moderate that the toes can easily be brought temporarily by the hand of the Surgeon into a straight line with the leg, and the heel be depressed to a natural position. The *second* class includes those in which the inversion of the foot and elevation of the heel appear the same or little greater than in those of the first class, but in which no reasonable effort of the Surgeon's hand will temporarily extinguish the contraction and deformity. The *third* class comprises those in which the contraction of the soft parts and displacement of the hard parts reaches the highest degree, so that the inner margin of the foot is situated at an acute angle with the inside of the leg, sometimes, or even almost in contact with it. Cases of the first and second grades may be respectively converted into the second and third grades by delay in the application of remedies, and by the effects of improper locomotion."—*Little.*

T. equinus, the more common acquired form.

Talipes *equinus* is the most common form of the acquired talipes, although Little positively declares it is at times congenital. It is found in every degree, from the inability to flex the foot beyond a right angle to a pointing of the toes, necessitating the patient walking upon the heads of the metatarsal bones and phalanges, the head of the astragalus projecting prominently on the dorsum of the foot. Fig. 420 illustrates the medium and extreme forms.

T. varus the more common congenital form.

Talipes *varus* is the more common congenital form. Fig. 421 illustrates it in three degrees of severity.

It is very frequently combined with T. equinus, as seen in Fig. 421A. The arrows in the figure indicate the direction of the convexity of the tarsus and metatarsus forwards and outwards; the perpendicular line through the axis of the limb shows the extent of the inward deviation of the metatarsus, by which the base of the little toe, being brought completely beneath the axis, has to support the entire weight of the body in walking.

Talipes valgus.

Talipes *valgus* may be of all degrees of severity, and may be congenital or acquired, these two varieties presenting very different appearances. Fig. 422 illustrates the congenital form in two degrees of severity, and also the acquired.

Talipes calcaneus.

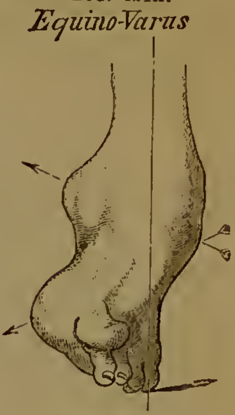
Talipes calcaneus is illustrated in Fig. 423.

For a full detail of the anatomical changes of the foot under these different conditions, *vide* Adams in 'Path. Soc. Trans.,' vol. iii.

Before considering the treatment of these affections it will be well to look into the principle upon which all interference must be based, and the process by which repair can take place after the division of tendon.

How repair of tendons takes place.

FIG. 421A.



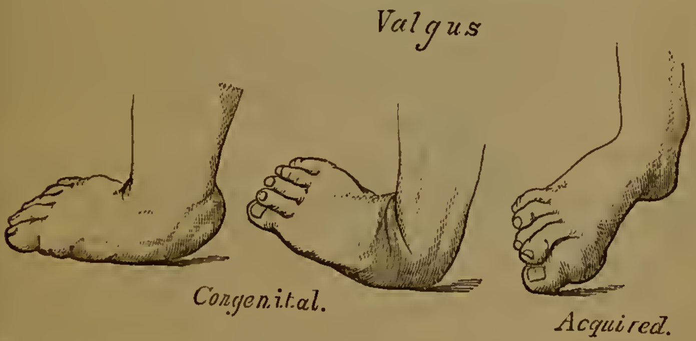
From Little.

To Paget and W. Adams, in this country, we are chiefly indebted for our knowledge of this subject, and I shall use as much as possible, Adams' description of this process, as published in 1860, in his work on the 'Reparative Process of Human Tendons after Division,' his investigations having confirmed those of the former, as well as added to our stock of knowledge.

When such a tendon as the tendo Achilis is divided subcutaneously the divided ends separate, in an infant for half an inch, and in an adult from one to two inches, the degree depending much upon the healthy condition of the divided muscle and the amount of movement subsequently permitted in the ankle-joint.

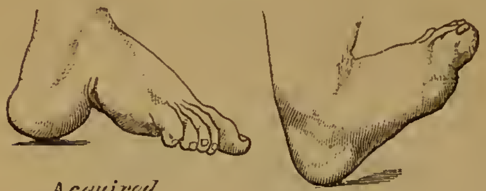
The reparative process begins by increased vascularity in the sheath of the tendon, which is followed by the infiltration of a blastematous material into its meshes, or spaces between its fibrous elements, exhibiting the development of innumerable small nuclei, a few cells of large size and irregular form, with granular contents, or, perhaps, with one or more nuclei, and studded with minute molecules of oil; a blastematous material, in which the cell forms do not develop beyond the stage of nuclei, appearing to be the proper reparative material from which new tendon is developed. This nucleated blastema soon becomes vascular, capillary vessels having been seen in it on the eighteenth day; the nuclei assume an elongated, spindle, or oat-shaped form, and are seen after the addition of acetic acid to be arranged in parallel linear series.

FIG. 422.



The tissue becomes gradually more fibrillated, and at last fibrous—a solid bond of union subsequently forming between the divided extremities of the tendon, which is tough to the touch, but to the eye presents, even for at least three years, a greyish, translucent appearance, distinguishing it at once from the glistening old tendon. This new tissue remains during life as permanent, and has little tendency to contract subsequently. Adams' observations rather led him to the conclusion, that the required portion of new tendon is to be obtained during a lengthened period of formation, that is, about two to three weeks, under the ordinary conditions of health; but, in paralytic cases as in others of feeble health, this period may be doubled.

FIG. 423.



Acquired *Congenital*

Talipes Calcaneus

Adams informs us also, that the divided extremities of the old tendon take no active part in the reparative process during its earlier stages, although at the later the cut ends become rounded and their structure softened. They become enlarged and exhibit a tendency to split, and thin streaks of new material similar to that already described are seen between the fibres; the ends are joined by these means. At a later period, the bulbous enlargement gradually diminishes.

When a tendon is divided a second time, there is but little separation of its ends, and this is probably due to adhesion of the new tendon to the neighbouring fibro-cellular tissue, in which fact is found an explanation of the unsatisfactory results of second operations.

Extension of uniting medium not required.

There is no reason for believing that, in the treatment of deformities by tenotomy, direct approximation and re-union of the divided extremities of the tendon must first be obtained, and that the required elongation is afterwards to be procured by gradual mechanical extension of the new connecting medium, as we would stretch a piece of india rubber.

Gradual mechanical extension.

Gradual mechanical extension, however, is required, in cases of *long standing*, as in those of *congenital* origin, to forcibly overcome ligamentous resistance, and to separate the ends of the divided tendons; as it is in those of *paralytic* and of *non-congenital* origin to prevent the too rapid separation of the extremities of the tendon. The mechanical extension should be carefully regulated according to the activity of the reparative process, as indicated by the amount of effusion into the sheath. Blood poured out into the sheath or any inflammatory action interferes much with the process of repair; any causes of general feebleness, coldness of the limb, too early, too late, or too forcible extension, having a like effect. With these remarks the operation itself may be considered.

Treatment of talipes.

TREATMENT.—"The indications," writes Little, "are to overcome the shortening of the muscles, ligaments, fasciæ, and integuments on the *contracted side* of the member, to direct the bones into their proper position, to educate the patient's voluntary use of the parts, to give strength to the muscles and ligaments in the *elongated* side of the member, and to combat the tendency to relapse."

When tenotomy is required.

To fulfil the first indications, mechanical means are often sufficient; and when these fail or are inapplicable, the division of the contracted structures is required. To carry out the other, mechanical means are also of value, aided by general measures, and more particularly by galvanism of the weakened muscles. In a large number of cases, however, instruments are not needed, much less tenotomy; since in any case of congenital or infantile talipes, when the foot can be brought into its normal position with but little force, a cure without operation can with some confidence be promised.

When tenotomy is *not* required.

Friction, &c.

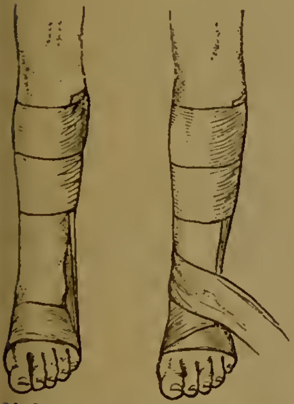
In the very simplest cases, mere friction of the affected limb and the daily extension of the contracted tendons is often enough to effect a cure, the nurse or parent holding the crooked foot for some ten or fifteen minutes two or three times a day in the required position.

Extension by strapping.

In the next class of cases, which are slightly worse than the last, in which the foot can be brought with gentle force into its natural place, a cure can be effected by means of strapping adjusted in the fashion depicted below (Fig. 424). The strapping must be of a firm nature; that spread on linen being the best, as made by Messrs. Gerrard and Co., or Leslie, and used at Guy's. The first piece acts as a kind of splint, and the second on binding down the first to the ankle, admits of any amount of force required to bring the foot in or out, according to the nature of the case. In a still more severe form, where the former method is inapplicable, a small tin splint covered with leather with a screw hinge at the ankle, such as that advised by Little, or made for myself by Milikin, of St. Thomas's Street, may be employed, the foot being forcibly brought into the required position and fixed there by strapping. Buchanan's splint, as seen in Fig. 425, is excellent.

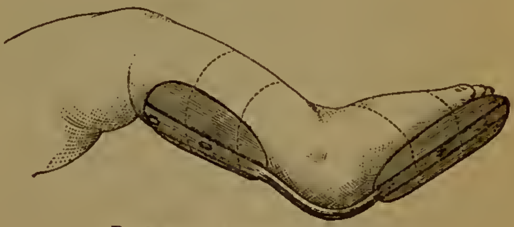
By splint.

FIG. 424.



Mode of stretching foot in talipes varus by strapping.

FIG. 425.



Buchanan's splint for talipes.

Tenotomy.

In the worst forms, where, by no ordinary force the foot can be brought into the required position, the division of the shortened tendon, tendons, or fascia should be performed, no more structures being divided than are absolutely essential.

When necessary.

"When deciding on the necessity of operation, the Surgeon must not be guided solely by the external configuration, but by the amount of firm resistance opposed to restoration, by the depth of the furrows existing in the sole and behind and above the heel, and by the degree of tension of the integuments above the internal malleolus. The deep clefts or furrows in question denote intensity of contraction of muscles, and closer adhesion than usual of integuments and fascia to the subjacent soft structures and bones. They probably denote, also, that the deformity dates from an early period of uterine existence."—*Little.*

Sayre's law upon this point is very good:—"Place the part contracted," he writes, "as nearly as possible in its normal position by means of manual tension gradually applied, and then carefully retain it in that position; while the parts are thus placed upon the stretch, make additional point-pressure with the end of the finger or thumb upon the parts thus rendered tense, and, if such additional pressure produces *reflex contractions*, that tendon, fascia or muscle must be divided, and the point at which the reflex spasm is excited is the point where the operation should be performed. If, on the contrary, the additional point-pressure does not produce reflex contractions, the deformity can be overcome by means of constant elastic tension, and the more you cut, the greater will be the amount of damage done."—'Orthopædic Surg.,' 1876.

Early treatment advisable.

In all cases treatment should be commenced *as soon as possible*, and the foot of the youngest infant may be dealt with advantageously by manual extension a few days after birth. Within a week, extension by strapping may be carefully employed, the foot being looked to daily to see that no sloughing or cutting of the skin by the strapping takes place. In infants the tendons yield far more readily than they do as months or years go on, and with care no harm can accrue from simple mechanical extension. Even splints, carefully applied, can be used.

When tenotomy is clearly a necessity—that is, in grave deformities—there is no reason, in a healthy well-developed babe, why it should not be performed within a month after birth. I have divided the tendo Achillis for a talipes varus, with an excellent result at the end of the first week, and Mr. Stromeyer Little has operated successfully within twenty-four hours of the child's birth.

Direction as to selection of tendons.

The Operation.—In a large number of cases of congenital varus the division of the tendo Achillis is enough, the foot after division of the tendon being generally capable of restoration to the required position by mechanical means, but in severe examples, the anterior or posterior tibials, singly or together may require to be cut. These three tendons may be divided at one operation in average cases, though in the severe, Little's advice is good to deal with the tibial tendons first and overcome the inversion of the foot, and, at a later date, to divide the tendo Achillis. The value of this proceeding consists in the fixed os calcis offering a resisting point from which the Surgeon is enabled to stretch out and unfold the contracted inverted sole.

Division of tendo Achillis.

Division of the Tendo Achillis.—The patient should be turned on the abdomen, and the tendon made tense by means of an assistant. The Surgeon should then insert a sharp-pointed or round knife flatwise from behind forwards by the side of the tendon as far as its anterior surface, when it should be turned laterally in front of the tendon and its cutting edge directed backwards towards the tendon, and, with the slightest sawing motion, the tense cord may be divided, care being observed to do this completely otherwise failure will follow. The Surgeon, during this procedure, should keep his finger upon the tissue to be divided, and immediately on the withdrawal of his knife, close the opening with his finger or thumb, the assistant relaxing the parts at the moment he feels resistance to cease. A dossil of lint should then be applied to the puncture and fixed by strapping, this dressing being left for three days. If any suspicion exist of the posterior tibial artery having been wounded, as indicated by arterial hæmorrhage and blanching of the foot, the dressing should be left on for at least a fortnight and all mechanical treatment postponed. It is, however, an exceptional circumstance for any harm to follow the puncture of the artery. Little, with all his experience, informs us that he has only once seen any trouble from this circumstance.

To be done completely.

Wound of tibial artery.

After the operation the foot in its deformed position should be bound to a flexible metal or other splint, for three or four days, till the immediate effects of the operation have subsided, when the foot should be at once brought to the required position and retained there by splints and bandages.

Division of the posterior tibial tendon should be performed with the child upon its back, with the limb to be operated upon rotated well outwards. The Surgeon should take charge of the foot and his assistant of the knee. The tendon should be divided about one inch, or one and a half inch above the extremity of the inner malleolus. In thin subjects, on abducting the foot, the tendon may be felt at the spot indicated; but in fat persons, and when the tendon cannot be made out, the Surgeon knows it lies along the inner edge of the tibia, "exactly midway between the anterior and posterior borders of the leg on its inner aspect."

Division of the tibialis posticus tendon.

At this spot the knife should be inserted perpendicular to the surface through the fascia for about half an inch, an opening in the fascia being made sufficiently free to admit of the introduction of the probe-pointed knife, which must next be inserted. This knife can then be introduced perpendicularly close to the bone, between it and the tendon to be divided, when its edge should be turned towards the tendon and the operation completed by a slight sawing movement. It is not always necessary to change knives during this operation, some operators, indeed, never do so. It is safer, however, to adopt the practice in fat subjects when some uncertainty exists as to the exact position of the tendon. As soon as the tendon has been divided, a dossil of lint should be applied, as in the former operation.

Some Surgeons prefer to divide the tendon of the long flexor muscle at the same time; as a rule, this is unnecessary.

Division of the anterior tibial tendon can be performed with the patient lying on his back and the foot extended, the tendon being in this way made prominent in front of the inner malleolus. The knife should be inserted at this point behind the tendon and its edge turned forward, when the tight cord can be divided—the foot being at once flexed, and the punctured wound covered with lint and strapping. It ought to be kept in a splint for several days, after division of the tendo Achillis.

Of tibialis anticus tendon.

When all these tendons are divided at the same operation, the after-treatment must be the same.

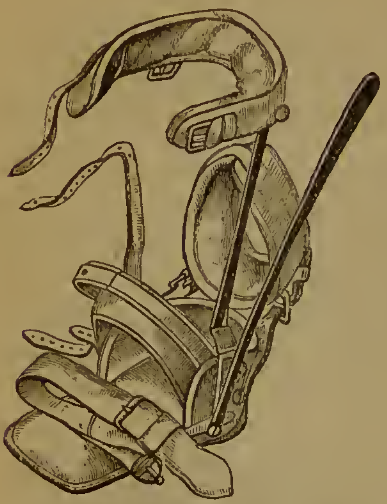
Of the peronei.

Division of the peronei tendons for talipes valgus is easily accomplished by adducting the foot and introducing the knife behind the external malleolus, between the tendons and the fibula—the tendons being cut on turning the edge of the knife towards them with a sawing movement. Some Surgeons advocate a higher division of these tendons to obviate their retraction, union taking place between the tendon and the sheath.

It is unnecessary to describe the operation for division of the *plantar fascia* or other tendons, as the practice in all should be conducted on principles identical with those already described.

Mechanical appliances.

Fig. 426.

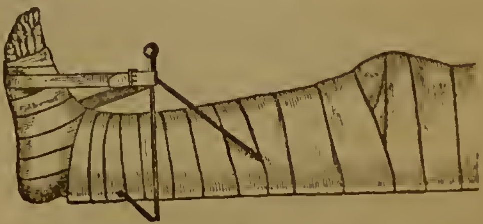


Little's modification of Scarpa's shoe for talipes.

Mechanical Treatment.—However necessary these operations may be in any given case, it ought to be remembered that they are only preparatory to the mechanical treatment, which is subsequently to be carried out. That they are not always necessary has already been shown, mechanical treatment generally being amply sufficient of itself to effect all the Surgeon desires.

In one case after the division of the rigid tendon or tendons a cure may be effected by means of strapping, as already illustrated (Fig. 424); in a second, a simple inside or outside splint with strapping or bandages may be enough. In a third the simple splint figured in Fig. 425 answers every purpose; while in a fourth Scarpa's shoe is required (Fig. 426), or some of its modifications. A shoe with a ball-and-socket heel-joint, which Messrs. Krohne made for me, is strongly to be recommended, and in Fig. 427 is another, suggested by my colleague Mr. Davies-Colley, which, for extreme examples of talipes, is inexpensive, and stands unrivalled.

Fig. 427.



Mr. Davies-Colley's splint for talipes equino-varus.

In all, the principle embodied is the same, the separation of the divided ends of the tendon and the deposition of new material between them. The splint invariably should be applied and fixed to the foot in its deformed position, and the separating process carried out on the third or fourth day. In many I have brought the foot into position directly after the division of the tendons with nothing but good results.

If failure follows the first operation a second may be performed, but the hope of a successful issue under these circumstances is far from good.

Barwell has recently revived the old practice of elastic bands to stretch the tendons in lieu of dividing them; and in some cases it is a valuable practice, but as a substitute for tenotomy it cannot be recommended.

Operative interference in talipes.

Removal of cuboid.

'Med.-Chir. Trans.,' 1857.

There are, however, cases of talipes equino-varus which are neither amenable to subcutaneous tenotomy, nor to mechanical appliances, as well as others which have been treated by these measures, and have failed, or which are so severe as to make it certain that a long interval of time must of necessity be spent in the attempt to bring about a cure, even if such a result were probable or possible; and under these circumstances Surgeons have sought for more expeditious and efficient means of treatment. With such a view Dr. Little, the pioneer of tenotomy in this country, suggested, so long ago as 1854, "that in inveterate varus the treatment might well be commenced in robust subjects by ablation of the os cuboides," and the late Mr. S. Solly, in 1857, carried the suggestion into effect. The case not proving very successful, the practice met with no encouragement, and the operation was not repeated till Mr. Richard Davy, an old pupil of my own, performed it at the Westminster Hospital in 1874, on a boy, æt. 15, with such a "striking immediate result that the sole of the foot could with force be placed in a natural position," and he repeated it in 1875-76. In 1872, Mr. Edward Lund went a step further, and removed from a boy, æt. 7, both astragali in a case of severe double talipes, with some perceptible improvement. This measure he repeated in March, 1878.

Of astragalus. 'Brit. Med. Journ.,' Nov. 2nd, 1878.

Of wedge of bone from tarsus.

'Med.-Chir. Trans.,' 1877

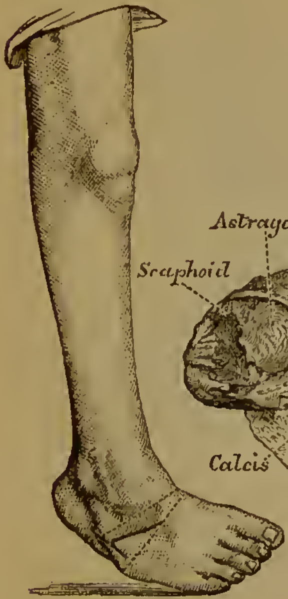
In October, 1875, however, my colleague, Mr. Davies-Colley, adopted a new method, and, on the suggestion of Mr. Howse, removed from a boy, æt. 12, a wedge-shaped piece of the tarsus without paying any regard to its articulations, by means of "an incision, three inches in length, along the outer border of the left foot, from the middle of the os calcis to the middle of the fifth metatarsal bone, and a second across the dorsum of the foot from the centre of this incision two inches long. Both feet were operated upon at intervals of six weeks, and in less than ten weeks from the second operation the wounds were quite healed, and the boy could walk without assistance. In November, 1876, Mr. Davy performed the same operation.

Choice of operation.

All these proceedings are sound in principle, and in cases of talipes in which minor measures have been tried and have failed, or in which the probabilities of their success are slight, and time and expense are questions of importance, they should be entertained. I believe, however, that Mr. Davies-Colley's operation is the best for talipes equino-varus, particularly when the varus is worse than the equinus, though Mr. Lund's operation is probably of value under the reverse conditions. I say this after having had opportunities of seeing several of Mr. Davy's and one of Mr. Lund's cases, and having carefully watched throughout its treatment Mr. Davies-Colley's. Entertaining these opinions, I performed Mr. Davies-Colley's operation on June 18th, 1878, and with such a good result that I now give drawings of the boy's foot before the operation (Fig. 427 A and B) and subsequent to it, with an outline of the portion of bones removed (Fig, 427C).

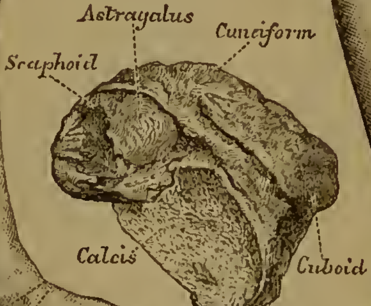
Example. The case was that of a boy, æt. 12, who was born with talipes equino-varus of the right foot, and went under surgical treatment when eight months, and again when five years old, but with no permanent relief. On admission into Guy's, under my care, on June 12th, 1878, the heel of the right foot was much drawn up, and the foot so twisted inwards as to cause the sole of the foot to face the median line of the body, as in a complete subastragaloid dislocation. The head of the astragalus was very prominent, and the tip of the inner malleolus approximated the base of the metatarsal bone of the great toe, the tubercle of the scaphoid being buried in the abnormal depression. By no force could the foot be restored to a better position, although the tendo-Achillis and tendon of the posterior tibial muscles could be made tense. Under the circumstances described it was tolerably clear that by no tenotomy or mechanical means could any hope be entertained of restoring the foot to a good position, and I consequently determined to perform Mr. Davies-Colley's operation.

FIG. 427A.



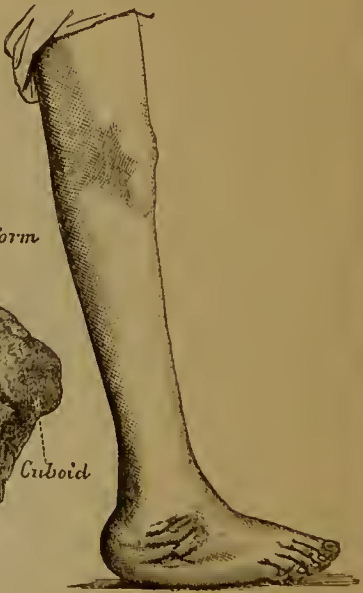
Foot before operation.

FIG. 427C.



Bones removed.

FIG. 427B.



Foot after operation.

Incision made. This I did on June 18th, 1878, by an oblique T-incision of the soft parts, and the application of a keyhole saw beneath the tendons and soft parts, made after Esmarch bandages had been applied as a tourniquet.

Bones removed. The wedge of bone I took away is represented in Fig. 427C, and was removed entire, great care being used to protect the tendons and soft tissues and particularly those of the sole, by the introduction of a flat retractor, during the sawing process.

The day following the operation the temperature went up to 102·4°, but fell the next day. On the third day, when the wound was dressed for the first time, it was 99·6°, and during the progress of the case it never deviated beyond a point or so from that degree. On July 11th, the bones having fairly united and the wound nearly closed, Davies-Colley's talipes splint was put on and the limb swung.

On Sept. 10th the boy got up, and the sole of the foot was found, on his standing, to be perfectly flat. An immovable splint was then applied, and the boy left for the country. On October 20th he returned to have the tendo-Achillis divided, with the view of giving more movement to the ankle-joint, and some success has followed the measure. He can now (November 10th) walk fairly well, with his foot as flat to the ground as the unaffected one. I have had three other cases since, and seen about six more which have been equally successful.

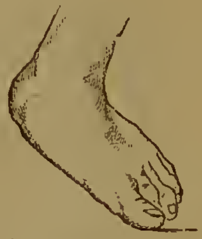
Clinical Society, 1878

Spurious Valgus, or Flat Foot.

Flat-foot.

Is a common condition in feeble boys and girls who stand much or take too much exertion. It is due to a giving way or yielding of the plantar arch and fibrous structures of the sole of the foot; "the key stone of the arch" the navicular bone eventually sinking with the astragalus and inner cuneiform bones, *vide* Fig. 428. In some cases there is as a secondary consequence contraction of the peronei muscles, and impaired movements of the ankle joint. This stretching of the tissues gives rise to more or less pain and in extreme cases to inability to walk or even stand. This affection is constantly associated with lateral curvature of the spine.

FIG. 428.



Spurious Valgus

Treatment.

TREATMENT.—In the milder form of cases when the foot can readily be restored to its normal position, a cure may be brought about by periodical rest, gentle exercise, and mechanical support, by means of strapping or the introduction of a firm pad or metal plate to support the plantar arch into the hollow of a boot made with a straight inside edge and low heel. Tonics and good air and living, and the free movement of the joint, are essential.

In a worse class of cases it is well forcibly to flex the foot and restore the parts to their normal position and then fix them so by means of a plaster of Paris bandage.

In more extreme cases some divisions of the tendons may be permissible and in the very worst, operative interference may be justifiable. Dr. Ogston, of Aberdeen, has suggested the union of Chopart's joint by pegging.

In examples in which much pain exists, nothing but absolute rest will be of any use; and in such the local signs of inflammation of the overstretched parts are often evident, and therefore fomentations, &c., may be employed.

Knock-knee, like flat-foot, is primarily due to mechanical yielding of the internal ligament of the knee-joint from want of power; and at a later date to the overgrowth of the inner condyle of the femur, with the lower end of the diaphysis from the want of the controlling influ-

Genu valgum.

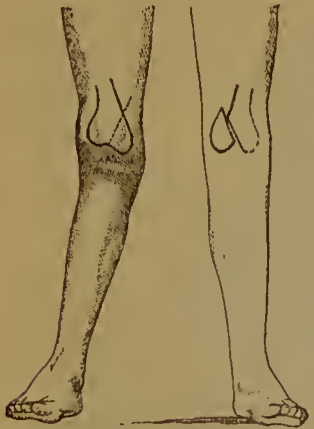
ence of pressure which normally is applied through the leg bones. It is found in growing boys and girls who stand too much and carry heavy weights, and in those of feeble power either from natural or acquired causes. It is not rarely seen with rachitis.

Treatment.

Irons condemned except in particular instances.

It can be treated on principles based upon the facts just briefly stated, and not purely by mechanical means. To put irons on the limb of a feeble subject is a mistake, for where the child is too weak to support his own frame without injury, to give him more to carry must be hurtful. Young children should be taken off their legs as much as possible, and provided with proper food and such tonic medicines as seem requisite. The weakened ligaments should have time given them to contract and become strong. Older children should be limited in the amount of exercise; rest and exercise alternating at regular intervals. When walking half an hour causes pain or aching, something less should be allowed, and so on. Exercise sufficient to get and keep the muscles in order may be allowed, but not sufficient to tell upon the weakened ligaments. In other cases, as an additional means, strapping the knees may be of great use. In more severe cases splints or irons should be employed. These latter instruments should extend from the pelvis to the foot, and be well jointed. In *very severe* examples operative interference may be justifiable, and the Surgeon has a choice of three measures:

Fig. 429.



Drawing illustrating Dr. Ogston's operation. *Right* limb shows line of section of the inner condyle of the femur. *Left*, inner condyle brought to required position.

Ogston's operation.

1st. *Ogston's operation* of obliquely sawing or chiselling *off the inner condyle* of the femur, and forcibly straightening the bent limb, which is kept fixed by splints and bandages during the period of repair (Fig. 429).

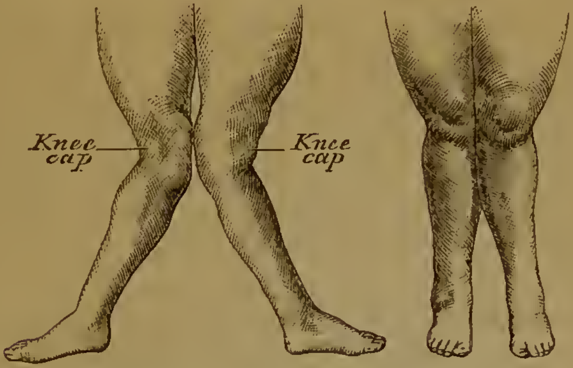
2nd. *Macewen's operation* of dividing with a saw or chisel the shaft of the femur *above the condyles*, forcibly bringing the limb straight, and retaining it in its new position for five or six weeks while the bone unites (Fig. 429A); the cutaneous incisions in both these operations being merely enough to admit the cutting instrument or saw.

3rd. The *forcible straightening* of the limb as advocated by Delore, pressing it straight, and giving time for repair.

Of these three the second, or Macewen's, is to be preferred, the results being as good, if not better, than Ogston's operation, and the operation is attended with less risk, the knee-joint not being opened. My colleagues and I have performed it on many occasions, and always with success. In the drawing below, one of the worst cases I have undertaken in an adult, æt. 33, the operation gave three inches to the patient's height (Fig. 429A).

Delore's operation is not to be advised, since it means not only the abruption of ligaments, but often the separation of epiphysis, and with such separation the dangers of local disease starting from the seat of injury, and the probable arrest of growth in the limb as a later consequence. Farabeuf and Mikulicza have fairly established this fact ('Gaz. Méd. de Paris,' Jan., 1880).

FIG. 429A.



Appearance of limbs before and after Macewen's operation in a patient æt. 33. The legs and feet rotated outwards and abducted.

Tenotomy for Contracted Limb, &c.

Besides all these recognised affections there are many other conditions in which tenotomy is a valuable operation. Thus, in the contracted limbs which are associated with hip, knee, or other joint disease, it is often necessary to divide the rigid and contracted tendons or muscles that forbid the limb being straightened by the application of any ordinary or justifiable force; while mechanical means can then complete the object the Surgeon has in view. It is better to divide than to tear a tendon.

Tenotomy in contracted limbs with diseased joints.

In 1871 I saw a boy, æt. 14, who for years had had repeated attacks of pain and inflammation about his great toe, more particularly after over-walking. He had been under the care of many medical men, who had treated him for gout, &c., but who had never compared the sound with the affected toe. When I did this the source of the evil was very apparent, for the long extensor tendon was clearly contracted, and at its insertion into the base of the extreme phalanx there was much thickening. I divided the tendon, and recovery at once ensued.

Contraction of toes.

The biceps muscle of the arm is also at times so contracted as to prevent extension. The adductor muscles of the thigh so contracted as to cause great apparent shortening of the lower extremity, and as a result limping. In both of these cases tenotomy is of great service. In fact, any tendon may contract under the influence of disease, and require division.

Of biceps.

Contraction of the Fingers.

In this curious affection, which generally appears in the little finger, and subsequently involves the ring finger, and in which the palmar fascia chiefly, and the flexor tendons secondarily, produce a permanent contraction of first one and then the other finger, so as to draw them into the palm, some operation is called for.

Contracted fingers.

It often attacks both hands, together or consecutively. It is said to be found more frequently in gouty or rheumatic subjects than in others, but I have failed to verify this statement. It is also difficult to trace the origin of the disease to any local injury; in

Course.

fact, this affection is somewhat obscure. It may attack the middle finger or any and all of the fingers, but more commonly it is the two outer. From its symmetry it has probably a constitutional, and not a local origin. It is often hereditary, but possibly not more so than any other deformity.

Treatment.

TREATMENT.—By fixing the contracted fingers in a flexible splint, and gradually stretching them, much may be done, and in several cases I have effected a complete cure by these means. But it is difficult for men patients to submit to this inconvenience, and, as a consequence, the Surgeon is only consulted when the disease is severe and the finger by its contraction has become useless, if not worse than useless. Under these circumstances, the free division subcutaneously of all the tense tissues may be called for, as recently ably advocated by Mr. W. Adams ('Brit. Med. Journ.,' June 29th, 1878). His operation and treatment is as follows:

Adams's operation.

1. The subcutaneous division of all the contracted bands of the palmar fascia and its digital prolongations by as many punctures as might be necessary, cutting from above downwards, with the smallest tenotomy knife.

2. Immediate extension of the contracted fingers. The fingers and hand to be bandaged to a splint.

3. The bandage not to be removed until the fourth day, when the punctures will be found to be healed.

4. Extension splint to be worn night and day for two or three weeks, and afterwards at night for three or four weeks, motion being employed every day.

Dr. Madelung's operation.

Dr. Madelüng, of Bonn ('Berliner Klinische Wochenschrift,' No. 15, 1875), believes that this condition of finger, known as Dupuytren's contraction, is due to the absorption of the numerous small deposits of fat which in healthy young and middle-aged subjects exist between the connective-tissue bands of the palmar fascia and the short fibres which connect this fascia with the superjacent integument. This fascia consequently, under the influence of pressure, falls into a state of chronic inflammation, and becomes contracted. He then describes how Busch, of Bonn, treats such cases with great success. In a case, for example, of contraction of the little finger, he raises an angular skin flap from the palm of the hand, its base being at the root of the finger, and then cuts away, bit by bit, the tense fascia beneath as the finger is being straightened. He then replaces the flap and fixes it with sutures. The finger is left free for some days after this operation, but as soon as granulations appear a cylinder of wood is placed in the palm for a few days, and after this the finger is extended and kept so by means of a straight splint applied to the back of the hands. This should be removed daily and the finger moved. At the end of three or four weeks the hand is left free. Dr. Madelüng has never seen this operation fail ('Med. Rev.,' May 26th, 1875). I have adopted this practice in several cases with excellent results. In the same way one or more toes may be so affected, and tenotomy may be called for.

Rigid atrophy.

Rigid Atrophy.—Muscles that atrophy occasionally contract and become rigid, but this rigidity must not be mistaken for the spasmodic contraction of a muscle or group of muscles, that is so common in progressive disease, more particularly of joint disease, although it often follows upon that form; indeed, it seems generally to be the consequence of some long-continued spasm, atrophy following from exhaustion, inflammation of the muscle, or what is called rheumatism. It is seen more commonly in the flexor muscles of joints than in any other, and, as a special affection in some cases of *wry-neck,* where the sterno-mastoid muscle is at fault.

Treatment.

TREATMENT.—When the muscles are not too rigid, much may be done by rapid extension under the influence of an anæsthetic, or gradually by means of splints, manipulation, or india-rubber bands, &c., suited to the wants of the individual case. When these means are ineffectual, or the parts too rigid to allow of their application, the subcutaneous division of the tendon of the muscle or muscles may be performed upon the same principle as tenotomy is practised in contracted tendons.

Wry-neck.

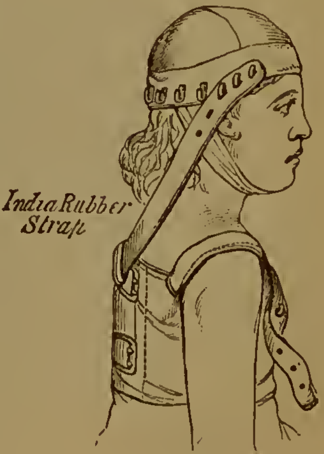
Treatment.

Wry-neck is an example of this affection due to a contracted sterno-mastoid muscle. It may be that the sternal or clavicular origin may be alone at fault, it being exceptional to find both divisions of the muscle affected. Under such circumstances, when the muscle refuses to be stretched by mechanical appliances, the half involved alone requires division, followed by extension when union has taken place. In these difficult cases it seems wise, as a rule, not to bring the divided ends of the muscle so closely into contact as the Surgeon usually does after division of a tendon.

Example.

One of the worst cases of the kind I ever had to treat was in a child, æt. 7, in which both origins of the muscle required division. I brought the head up to the required position on the second day, and kept it there, an excellent result ensuing. In another which I treated in 1870, in a child, æt. 6, with Mr. Duke, of Battle, the muscle of the left side was two inches shorter than that of the right from contraction of its sternal half; I applied extension on the third day, after the division of the contracted portion, and brought the head into its right place, keeping up the extension by means of a piece of india-rubber band an inch wide, which was fastened to a skull cap on the opposite side of the head and passed backwards across the shoulders and beneath the axilla of the affected side to fasten to a good thoracic belt (Fig. 430).

FIG. 430.



Cap and band for extension in wry-neck.

These cases of wry-neck due to contraction of muscles, are always associated with some arrest of growth in the upper and lower jaws on the affected side.

Mr. De Morgan informs us ('Med.-Chir. Rev.,' 1866) that in a case that failed to yield under such treatment he took away a piece of the spinal accessory nerve with permanent benefit, the sterno-mastoid and trapezius muscles being of necessity paralysed. This operation has been repeated, but with only exceptional success.

Division of muscle.

The *operation* of dividing the sterno-mastoid muscle either wholly or in part at its sternal or clavicular origin, must be subcutaneous, and requires much care, for important parts lie behind the muscle which may be injured. A punctured wound down to the muscle should be made over the part to be divided with a sharp-pointed tenotomy knife; a blunt-pointed knife ought then to be introduced with its edge turned towards the muscle close to its bony attachment, and all resisting fibres divided by turning the edge backwards, an assistant putting the muscles fully on the stretch; the muscle usually gives way with a distinct snap. The thumb or finger must then be applied to the part and a pad adjusted, sufficient pressure being made to prevent bleeding, but no more. As already stated, extension should be made early in the case, after the second or third day, and the means adopted in the example quoted seems to be the best; it succeeded at any rate, where the usual instruments failed.

When both insertions require division, it should be effected by two different punctures. Some Surgeons prefer to divide the muscle from behind forward, but there is greater risk of injuring the deep parts by this practice than by the one advised.

Wry-neck resulting from spinal disease.

I need scarcely add that where wry-neck is due to spinal disease, no such treatment as the above is applicable.

CHAPTER XXX.

CONTUSIONS, SPRAINS, WOUNDS, INJURIES OF JOINTS, AND DISLOCATIONS.

Sprains of joints.

Sprains may be very slight or very serious indirect injuries. They include more or less severe overstretchings if not lacerations of the ligaments that bind the bones of an articulation together. Some fracture or tearing away of the bone at the attachment of the ligaments, "sprain fractures." In children under ten, sprains of joints are liable to be complicated with some epiphysial separation or incomplete fracture near the epiphysial line; or some crushing or compression of the spongy bone-tissue. In the more severe instances are included lacerations of the muscles, tendons, and soft parts that surround the joint. All such accidents require rest and time in their treatment in order that repair may be complete; since neglected sprains are often the cause of joint or bone disease.

Contusion of joints always serious.

Contusions of joints as direct injuries, always ought to be regarded in a serious aspect, for a large amount of internal mischief may often be sustained with very slight external evidence of injury, and, under certain conditions of health, a slight blow upon a bone is often enough to set up severe local action or to excite chronic changes which may involve the integrity of the joint. During the period of the growth of bone in children these observations have great force. The nature of the accident and the amount of force concentrated on the joint is the best index to the case, and, under all circumstances, the prognosis should be guarded and the treatment cautious.

Treatment.

TREATMENT.—"In sprains of joints, rest is the first principle," said John Hunter, in 1787 (MS. Lectures), and at the present day the same words are as pregnant with truth as when then spoken; indeed, in simple cases of sprain, by such treatment alone will convalescence be established. When swelling and effusion into the joint ensue in the course of the second or third day after the accident, the evidence of internal injury is more marked, for such effusion means inflammation or synovitis, which is to be treated by absolute rest, insured by the application of a splint, the local use of cold or warmth, according to the comfort afforded by either, and occasionally by leeches.

Rest.

If swelling of the articulation follows immediately upon the injury, effusion of blood into the joint is indicated with or without fracture, but always with severe local mischief. Such cases should be treated by the employment of a splint to ensure immobility of the articulation, elevation of the injured joint with the patient reclining, and the local application of a bag of pounded ice, or Leiter's metallic coil (Fig. 8½); these means being maintained until the hæmorrhage has ceased, all risks of inflammation of the joint gone, and repair appears to be going on satisfactorily. As soon as the primary effects of the sprain and all signs of inflammation have passed, the application of pressure to the joint by means of a bandage or strapping with passive movement is very striking. When the joint is rendered very tense from effused blood it may be aspirated.

Where much effusion, splints, ice, &c.

When the muscles over the shoulder joint are severely bruised by a fall, much local pain may be produced, as well as want of power in the arm, exciting a fear of either bone or joint mischief; but a careful examination will show, if no roughness in the examination be used, that the joint can be passively moved without exciting pain, although if the patient attempts to set the muscles in action, pain is produced. This point is one of clinical importance, indicating that the mischief is in the muscle and not in the articulation, the pain being excited by muscular action and not by joint movement.

Where muscles bruised.

In delicate children, all falls upon the hip followed by pain should be treated by rest and extreme care; for a large number of cases of hip disease originate from some such trifling cause, and there is good reason to believe that the majority of hip-joint affections might be prevented by proper attention after slight injury.

Contusion of hip in children.

When the immediate effects of the sprain have passed away, the local use of a stimulating liniment and moderate friction of the part expedites the cure, and, at the same time, gives comfort to the patient. A local warm bath at intervals likewise relieves the stiffness of the joint. Whenever movement excites more than a momentary pain, rest should be observed; and if the pain continue, some chronic inflammatory change ought to be suspected and treated. When weakness of the joint alone remains, a good bandage or strapping around the part to give support is of great benefit. Where much laceration of ligament has taken place, it is at times necessary for the joint to have some permanent artificial support, either in the form of a splint, felt, leather casing, or bandage, for no parts are repaired with less permanent power than ligaments.

After-treatment of contusions.

Artificial supports.

In the wrist, when much swelling exists, a sprain may be mistaken for a fracture or a fracture for a sprain, as fractures about the end of the radius are generally impacted, and not consequently attended by crepitus. Much care is necessary in the diagnosis of such cases. Many sprains of the ankle are also really cases of fracture of the fibula above

Avoid mistaking for fracture.

the malleolus. The popular notion that a severe sprain is worse than a fracture is in the main true, and, when the sprain is neglected, the case is always more tedious than that of a broken bone.

Wounds of Joints.

On wounds of the joints.

These are always serious accidents, yet as a whole, if treated with discretion and at an early period of their existence, they are fairly successful in their issue. Lacerated, incised, and punctured wounds are met with, and the symptoms that follow any one of these accidents are by no means commensurate with the extent of the local injury, for a slight or punctured wound is often followed by severe and destructive local changes, when an extensive one heals without giving rise to any mischief.

Symptoms of a wounded joint.

Prognosis. guarded.

A joint is known to be wounded when its contents escape, the oily, glutinous nature of synovia rendering its flow very manifest. In fat subjects, however, wounds over joints give exit to an oily fluid, simulating "joint oil;" but such fluid is not sticky when rubbed between the fingers as is synovia. Joints are sometimes wounded without any evident escape of their contents, such doubtful cases are clinically to be treated as cases of wound. In every case of wounded joint however trivial, and in all doubtful cases of wounded joints, the *prognosis* must be very guarded and the *treatment* cautious.

Treatment.

Sutures.

Splint.

Value of cold.

Sealing a wound.

When inflammation superveues.

Treatment.—A clean incised wound should be well cleansed with carbolic or iodine water, and its edges accurately adapted with sutures; a contused or lacerated one should likewise be well washed and the joint syringed, and if the edges of the wound are brought partially together, sufficient opening should be left for drainage. The wound in both cases should be dressed with some absorbent antiseptic dressing such as iodoform or carbolic gauze. Probing must be avoided and the joint should be kept in absolute repose by the application of a splint. Cold should then be applied, nothing checking pain or subduing inflammation and effusion better. The cold, however, to be of value must be persistently maintained, as any intermission of its use is almost sure to be followed by increase of pain and effusion. To seal hermetically a small wound with a piece of lint soaked in the compound tincture of benzoin, and at the same time apply cold is excellent practice. Should an interval have passed between the receipt of the accident and the application of the cold, and much joint inflammation exist with constitutional symptoms, the application of leeches to the joint, and subsequently of cold, is beneficial. In exceptional examples, where cold is not tolerated, warm fomentations must be substituted. Opium is always of use, the patient being kept fairly under its influence by one grain two or three times a day. Mercury is useless. In very sthenic cases, antimony may be given, and colchicum where gout is suspected.

When inflammation becomes chronic.

When suppuration of joiut.

When all acute symptoms have subsided and chronic effusion remains, the application of a blister or blisters expedites the absorption of the effused fluid, and the benefit of pressure by the adjustment of well-applied strapping is very great. In feeble patients, tonics are required. Should suppuration appear, active treatment is called for, such as a free incision into the joint, or other means which will be considered under the head of suppurating joints.

Extensive wounds of large joints complicated with other injuries had better be treated by amputation or excision.

DISLOCATIONS.

On dislocations.

A joint is said to be dislocated when the articular surface of one bone is displaced from another. When the bone is wholly displaced the dislocation is called "*complete*," but when otherwise, "*partial*" or *incomplete.*

When a wound communicating with the joint complicates the case it is known as a "*compound,*" and when not so associated as a "*simple*" dislocation.

Congenital. Pathological displacement

Congenital dislocations are cases of malformation, and the displacements of bones produced from disease are accidental complications of a more serious affection. In the present chapter neither of these two conditions will receive attention.

Flower's and Morris's Middlesex Hospital Statistics ('Holmes' System,' vol. i, ed. 3rd) tell us that, out of 756 cases of dislocation of the upper extremity, treated in twenty-six years, 20 were of the clavicle, 16 of the scapula, 375 of the humerus, 112 of the elbow, 137 of the thumb, and 78 of the phalanges. At Guy's during the ten years ending with 1883, out of 46 dislocations of the lower extremity 25 were of the hip, 7 of the patella, 10 of the bones of the foot, and 4 partial of the knee.

Causes.

Dislocations are mostly caused by external violence, but they occasionally occur from muscular action, as in dislocation of the lower jaw. I have known, however, the head of the humerus to be displaced by the exertion used in the violent throwing of a stone, and by the spasm of muscles in an epileptic fit. I have likewise seen the hip-joint dislocated by mere muscular action. Schoolboys are also familiar with the dislocation of the thumb at the carpal joint, which some young persons who possess relaxed ligaments are capable of producing at will.

Effects. Primary.

Laceration of the ligaments more or less complete, as well as of the capsular ligament, is a usual accompaniment of all dislocations with more or less injury to the muscles and soft parts that surround the injured articulation. In exceptional cases the capsule, instead of being torn, may be simply stripped off the bone. At times the nerves are pressed upon or lacerated, and the main artery pressed upon, stretched, or divided. In shoulder dislocations the circumflex nerve is frequently torn, and the popliteal artery injured in knee dislocations. In all joints, more particularly in the ankle, dislocation may be complicated with fracture.

Secondary effects.

After a dislocation has been reduced, most of these injuries are steadily repaired, although some weakness of the joint often remains, and some impairment of mobility. When nerves have been injured more or less complete local paralysis or want of power follows in the muscles supplied by the injured nerves.

New joint.

When a dislocation has been overlooked or neglected, secondary and, in a measure, reparative changes take place, and a new joint is formed. To effect this, new products are poured out around the bone in its new position, which organize and ossify (Fig. 431). The cavity thus formed becomes lined with a dense layer of fibrous tissue, putting on the external aspect, and serving instead of cartilage. The head of the bone becomes at the same time altered in shape, and surrounded by the condensed cellular tissue of the part, which answers for a new capsule. A large amount of mobility is often secured, particularly in the

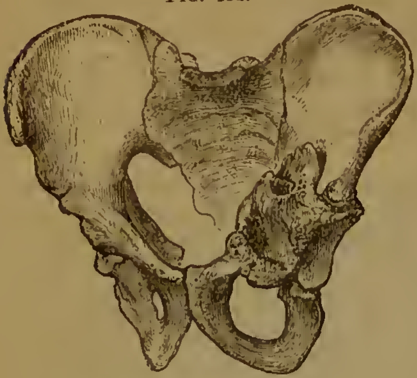
Pathological condition.

ball-and-socket joints. When, however, the original articular cavity becomes gradually filled in with fibrous tissue, the muscles, tendons, and soft parts that have been torn or misplaced make fresh attachments, and ossific matter is deposited in the tendons.

Cadge's case.

How long these secondary changes take to form is not yet decided. In some patients they doubtless occur rapidly, and in others slowly, as Brodhurst and Fournier both ('St. George's Hosp. Rep.,' 1868) record a case in which the cartilage of the acetabulum was found healthy, and the cups unfilled, three years and ten years respectively after a dislocation. Cadge also records a singularly instructive example ('Med.-Chir. Trans.,' vol. xxxviii) of an unreduced dislocation of the head of the femur upwards between the two anterior spinous processes of the ilium of sixteen years' standing, in which "the new bone was deposited in such abundance that it formed a new and complete acetabulum, so complete as, indeed, to hold the thigh bone suspended after all the soft parts were removed, and make it requisite to saw off a large piece of the new bone, in order to set the femur at liberty. The new cavity, thin at its walls and smooth on its outside was lined by a dense pearly white tissue which resembled fibro-cartilage. The head of the femur was still covered with cartilage. The old acetabulum had disappeared, partly by the absorption of its cotyloid margin, by a deposit of new bone, and partly also by a mass of dense fibrous tissue."

Fig. 431.



False joint after dislocation of the head of the femur. From Sir A. Cooper.

Diagnosis and symptoms of dislocations.

Diagnosis and Symptoms.—Typical examples of dislocation when seen at an early period of their existence are not difficult of diagnosis; although partial and even complete dislocations, some days after the accident, when swelling of the parts has taken place, are often obscure. The frequency with which such cases are overlooked, even by good men, forbids our saying they can always be made out.

Compare injured side with sound side.

Deformity.

Loss of voluntary power.

Impaired mobility.

In every case of suspected dislocation the Surgeon should compare the sound with the injured side, and in difficult cases, in young or sensitive subjects, we should make the examination with the patient anæsthetised. In doing this he will at once detect the most obvious result of any dislocation—deformity—and be able to make out the direction the displaced bone has taken; he, moreover, will see whether the limb is longer or shorter, or more abducted or adducted than its fellow. The patient will have lost all power of voluntary movement; the Surgeon, by manipulation, will discover that where mobility formerly existed such will be seriously impaired, and that the attempt to obtain it causes severe pain. There will be an absence of crepitus, unlesss some days have passed since the accident, when the crepitus of effusion into the joint or into the bursæ about the joint or tendons will often be felt. *Deformity, loss of the power of voluntary motion*, and *impaired mo-*

bility, coming on after an accident, are the three most marked symptoms of dislocation. Indeed, these symptoms by themselves, with the absence of crepitus, are usually enough to enable the Surgeon to diagnose a dislocation from a fracture. They are not enough, however, to distinguish it from the separation of an epiphysis; an accident prone to affect subjects under the age of twenty-one.

Treatment of dislocation.

Immediate by extension or manipulation.

TREATMENT.—In all cases, the reduction of the dislocation or displacement should be effected as soon as possible, delay being only justifiable when the appliances required for the purpose are not at hand or the diagnosis is uncertain. Most dislocations, not excluding those of the hip, may be readily reduced directly after their occurrence by extension or manipulation without the aid of an anæsthetic; but, when any time has been allowed to pass and the immediate constitutional effects of the accident have subsided, it is a fair question whether it is advisable to attempt reduction before anæsthetising the patient; for, under the most favourable circumstances, without this aid, much force will to a certainty be called for, whilst with it the gentlest manipulation is often enough. Indeed, I believe it to be wiser for the Surgeon to delay any attempt to reduce a dislocation till an anæsthetic can be obtained than to make it without, for the slight harm that ensues from the delay is more than compensated by the great good secured by its use. In no department of surgery is the benefit of anæsthetics better demonstrated than in this, for where force formerly reigned, gentleness now suffices, and where difficulty and pain were common accompaniments, facility of reduction and painlessness are now the rule. Their use has superseded the old treatment by venesection, tartar emetic, the string of students, and the pulleys. Under their influence, all muscular spasm ceases to be a force which has to be overcome, and the Surgeon has simply to replace the bone through the rent in its capsule, by such gentle manipulative acts as the special requirements of each case appear to indicate. The facility, however, with which a dislocation is reduced by manipulation, turns much upon a Surgeon's knowledge of the way the dislocation was produced; for, in a general sense, the best way to reduce a dislocation is to make the head of the bone retrace the course it followed after it had first burst through its capsule; the untorn parts in the capsule being doubtless the main obstacle to reduction; muscular spasm is eliminated by the use of an anæsthetic.

When delayed, chloroform to be used.

Value of anæsthetics.

In neglected cases.

In neglected cases of dislocation where false joints and adhesions exist, force is called for to break them down and pulleys may be wanted, but they must always be employed with the greatest caution, and under a healthy fear, for not only may the axillary artery be torn and ligaments lacerated, but worse injuries may ensue; thus, in Paris, in 1864, the forearm of a woman, æt. 64, was torn off at the elbow-joint in the attempt to reduce a dislocation in the humerus, and in London, more recently, the same dreadful accident has taken place. Agnew in his "Surgery" gives 24 cases of injury of the axillary artery brought about in attempts at reduction of old dislocations of the humerus, and of these 15 were fatal.

After-treatment.

After the reduction of a dislocation, the limb should be kept at rest, and fixed by bandages on a splint; Sedillot's rule of "simply placing the joint in a position the opposite of that in which it was when the dislocation occurred" is sound. When any signs of inflammation show themselves, cold, in the shape of ice in a bag, should be employed; leeches are seldom called for.

Three or four weeks are at least required for repair to take place before any useful free movement of the joint can be allowed, although when no inflammatory symptoms appear, passive movement may be permitted at the end of two weeks; in dislocation of the hip, no walking or standing should be permitted for a month.

When reduction cannot be accomplished.

When reduction cannot be accomplished after a reasonable attempt, a second one may be made at a subsequent period after the effects of the first have passed, that is, if any sound hope exists of success being secured; some modification of the means employed probably suggesting themselves to the Surgeon, upon reflecting as to the peculiarity of the case and the cause of his failure.

When the patient is an adult the difficulties and prospects of the case should be laid before him and his opinion taken; not, however as to the desirability or the reverse of the attempt, for such an opinion belongs to the Surgeon and his colleagues only, but as to the risks that must be run, for in many cases failure of reduction, more particularly of forcible reduction, is followed by some destruction of the new joint that nature has partially formed, by some inflammatory change that may end in the destruction of the joint, or in rendering its usefulness still less promising.

Propriety of attempting reduction of old dislocations.

With respect to the propriety of attempting the reduction of an old dislocation, no definite rules can be laid down, and since anæsthetics have been introduced, those originally given by Sir A. Cooper and generally followed, require modification. Sir A. Cooper gave three months as a limit to the attempt in the shoulder, and eight weeks in the hip; yet Sedillot reduced a dislocation of the shoulder more than a year after its receipt; Brodhurst on the 175th day; Smith (U.S.) at the seventh and tenth month; whilst Breschet reduced a dislocated hip on the seventy-eighth day, Travers and my colleague Mr. Durham at the fifth month; Blackman (of Cirencester) at the sixth month. Yet such cases must be rare. Ball-and-socket joints are also more readily replaced than others. The best guides the Surgeon possesses for his decision are found in the amount or absence of repair that is present in the dislocated joint. When the movement is good, there is small reason for making the attempt; for, writes Fergusson, "after three months the use of the limb is not, when reduced, greater than that which it would have acquired in its dislocated state."

When the movements are very limited, a cautious attempt to reduce the dislocation is hardly likely to be followed by a bad result, at whatever period it is made; but, as previously stated, the patient and Surgeon should take counsel together on the point and share responsibility.

To reduce an old dislocation.

To facilitate the reduction of an old dislocation, it is needless to say, some anæsthetic should be employed, and as a primary step all adhesions should be broken down by free rotation or forcible movements of the joint. When this has been effected, the head of the bone ought to be replaced by manipulation, or by slight extension, forcible extension being inadmissible. When tendons are very rigid and forbid movement, they should be divided subcutaneously, but this should be done some days before reduction is fully attempted.

On compound dislocations.

Compound dislocation is one of the most serious accidents that can befall a limb, and in the larger joints is generally complicated with fracture or torn arteries. In the knee-joint the popliteal artery is generally lacerated, and, under such circumstances, amputation is the only resource. In the ankle-joint where the accident is most commonly seen, the case should be treated as one of fracture and wounded joint by immovable splints after its reduction, and the persistent application of cold. In exceptional cases only, when the soft parts are much injured, and in very feeble subjects, ought amputation to be thought of; excision of the articular surface being always a point for consideration. In the elbow where movement is of essential importance, excision had better be performed when the wound is large, although recovery with movement of the joint may take place without it in young adults. Under all circumstances, the dislocation ought to be reduced, the question of excision or amputation turning upon the amount of mischief the soft parts or bones have sustained.

Compound dislocations and compound fractures into joints are clinically of very similar import.

On dislocation with fracture. Fracture and dislocation.

When *dislocation and fracture co-exist*, difficulties are often met with, but the reduction of the dislocation is often possible by manipulation aided by anæsthetics, where, without, it is impossible; and I have reduced with its aid in one case the head of a fractured humerus from the subglenoid position; and in another a forearm displaced backward with fractured arm-bone, and afterwards in each case adjusted the fracture with facility; I have likewise seen the head of the femur displaced upon the pubes pressed back into its socket, notwithstanding that a fracture of the shaft existed. I believe that in the majority of these cases the dislocation may be successfully treated before the fracture, the fractured bone being at the same time moderately extended. It may be prudent in some to apply splints before attempting the reduction of the dislocation, but such a step is not always necessary or indeed advisable, for with the limb encased in splints the Surgeon has less influence upon the dislocated bone. When the dislocation cannot be reduced, the fracture must be dealt with in the ordinary manner. In a case I recently had under care, of a woman æt. 66, in which the head of the femur was dislocated into the sciatic notch and an impacted fracture of the neck of the thigh-bone co-existed, a good limb was secured.

Separation of Epiphyses.

In all young patients and in others under twenty where a dislocation or fracture near a joint is said to be present the Surgeon should suspect the injury to be one of partial or complete separation, with or without fracture of an epiphysis, and particularly when any of the joints of the upper extremity are involved; for whilst dislocation of the shoulder-joint in children are very rare, incomplete separation of the shaft of the humerus from its upper epiphysis is not seldom met with (Fig. 483), and by far the majority of cases of supposed dislocation at the elbow-joint in young subjects are examples of displacement of the lower epiphysis of the humerus together with the forearm bones. The same remarks are likewise applicable to the wrist-joint, dislocation of such in young people being almost if not quite unknown, whilst separation of the lower epiphysis is probably comparatively common. A pretty example of this kind is to be seen in Fig. 488.

In the lower extremity these cases are possibly rare. I have, however, seen several examples of displacement of the lower epiphysis of the femur with the tibia and fibula, and give an example of this accident in Figs. 464A and 519 and I believe that what are regarded as severe sprains of the ankle in children are often due to some displacement of one or other of the malleolar epiphyses, since I have seen many examples of arrest of growth in limbs that had been supposed to have been previously the seat of sprains.

I have, moreover, certainly seen two cases of displacement of the foot outwards with the lower epiphysis of the tibia, one of which was compound, with the ends of the diaphysis presenting through the wound. It occurred in March 21, 1884, in a boy æt. 15, from the foot being caught between the spokes of a revolving wheel. The parts were readily restored to their normalposition and a good recovery ensued. The epiphysial cartilage in this case seemed to be attached to the diaphysis. How far arrest of growth in the bone will ensue time must prove.

Again, there is good reason to believe that some examples of acute suppuration of joints following injury have been brought about by this cause, and that a partial or complete separation of an epiphysis in the hip, shoulder, elbow, wrist, or ankle-joint, associated with a tearing away of the periosteum from the diaphysis with which the epiphysis is associated, is occasionally followed by acute periosteal inflammation of the injured parts, complicated with suppuration of the contiguous joint and not rarely with acute articular necrosis.

DISLOCATIONS OF THE UPPER EXTREMITY.

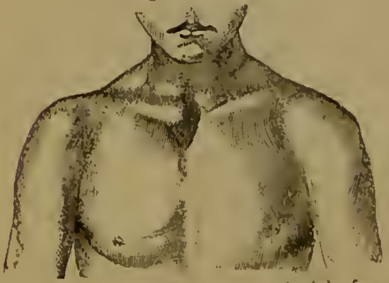
Dislocations of the spine and lower jaw have been considered in former chapters (pages 320 and 631, Vol. I). Those of the upper extremity will now occupy our attention.

Dislocations of the Clavicle.

Dislocation of the clavicle.

Dislocations of this bone at its sternal end are rare accidents, though according to Flower they form about 3 per cent. of all dislocations of the upper extremity. They are produced by violence applied to the shoulder, when the scapula is fixed, the clavicle being forcibly thrown towards the mesial line. Dislocation *downwards* is an impossibility, the cartilage of the first rib preventing; but it may take place *forwards*, *upwards*, or *backwards*, and may be partial or complete.

FIG. 432.



Dislocation of sternal end of clavicle forwards. Drawing 27^{21}, Guy's Mus.

Dislocation forwards.

Dislocation forwards is usually caused by some violent pressure of the shoulder backwards, although Melier ('Archives Gén. de Méd.,' tom. xix) records a case in a child where it was produced by simply pulling the arm. The head of the bone in this accident forms a marked feature, and cannot be mistaken for anything else (Fig. 432). When the dislocation is *partial*, some unusual prominence of the end of the bone on comparing it with its fellow will suggest its nature, the bone being only

Characters.

covered with skin and readily pressed back. When *complete*, the nature of the accident will be still better marked; and the end of the bone will be usually found pointing downwards. Inflammatory thickening of the joint should not be mistaken for partial displacement.

Treatment.

TREATMENT.—There is usually little or no difficulty in reducing this form of dislocation, by forcibly drawing back the shoulder and applying pressure to the displaced bone; though there is great difficulty in keeping the bone in its normal position; indeed, as a rule, it is quite impossible to do this satisfactorily. In one case I succeeded, by keeping the patient on his back in bed for three weeks with his arm bound to his side. A pad in the axilla, with a figure-of-8 bandage to keep the shoulder outwards, the elbow being bound to the side, will do much towards the desired end; and a pad of lint applied outside the displaced end of the clavicle, and firmly fixed in position by strapping carried over the shoulder and scapula, has a very beneficial tendency. Nélaton advises the use of a common hernia truss. The Surgeon, however, must expect a certain amount of failure in the treatment of these cases, though he may safely assure his patient that the usefulness of the arm will be but little, if at all, impaired. I have had one case of this dislocation combined with fracture of the sternal end of the bone, in which the dislocation was reduced by manipulation and the arm bandaged with a good result.

Dislocation upwards.

Dislocation upwards is very rare. Malgaigne has recorded four such cases, Hamilton another, described by Dr. Rochester, of Buffalo, and Dr. R. W. Smith a sixth ('Dublin Journal of Medical Science,' 1872). In 1865, such a case came under my care. It was in a young woman, a milliner, æt. 20, who two years before was violently crushed in a crowd, the violence causing pain which was referred to the upper part of her chest. She was treated at home and got well, although with a deformity, for which she consulted me. On examining her chest the sternal ends of both clavicles were felt above the upper border of the sternum, behind the sternal tendons of the sterno-mastoid muscles, and, with the slightest pressure upon the shoulders, the two ends could be made to meet. By drawing the shoulders backwards, the bones could be separated and pressed back into what appeared to be their normal position, but no appliance could keep them there. The patient had good movement in her arms, and followed her occupation. I have the notes also of a second case that came under my care in 1863, in which one bone was displaced; it occurred in a man, æt. 35, and was produced by a fall on the shoulder.

Characters.

In the Guy's Museum (1292^{90}) there is a specimen of dislocation of the clavicle at its sternal end upwards and forwards. It was taken from a man, æt. 40, who fell from a height and died nine days later from pneumonia.

Treatment.

TREATMENT.—In the treatment of this as of the last form of dislocation, there is no difficulty in reducing it by drawing outwards the shoulders and applying pressure upon the bone, but there is much in keeping the bone in position. The best means, however, are the application of a pad over the bone, the firm pressure of the scapula against the ribs by means of broad bands of strapping, and the supine position. Under all circumstances, the Surgeon may comfort the patient by the assurance, that good and useful movement of the arm will be secured. *Overhand* movements, however, will always be difficult.

Dislocation backwards.

Examples.

Dislocation backwards stands next in point of rarity to that of dislocation upwards, and is usually caused by violence, forcing the shoulder forwards, or by direct force. I have seen but one such case, in a man, æt. 52, who was crushed by falling bricks, and in it the dislocation was self-reduced on the second day, when the man was in bed. The displaced clavicle presses at times upon the trachea and œsophagus, so as to interfere with respiration and deglutition. In 1845, a sailor, æt. 17, was admitted into Guy's with such an injury, the dislocation having been caused by a blow on the shoulder. It was easily reduced by drawing the shoulders back, and maintained *in sitû* without difficulty. Cases of this kind have been recorded by Mr. Brown, of Callington ('Med. Gaz.,' 1845), and M. Pellieux, 1834 ('Revue Médicale'). In one singular case recorded by Sir A. Cooper, the dislocation was produced by curvature of the spine, and Mr. Davie, of Bungay, excised the sternal end of the displaced bone to prevent death from suffocation. Mr. C. De Morgan has recorded a case in 'Holmes's System,' in which, in a girl, æt. 10, the bone was thus displaced and successfully treated by means of a splint across the shoulder, with a pad between it and the spine, the shoulders being drawn to the splint by a bandage and the child kept in bed. The splint was removed at the end of a fortnight, and the articulation in four weeks became as firm as that on the other side; the arm, moreover, could be moved without causing any pain.

Separation of epiphysis.

A separation of the sternal epiphysis of the clavicle may take place and be mistaken for dislocation. This can, however, only occur in young life. Mr. C. Heath brought forward an example of this kind in November, 1882, before the Clinical Society. It occurred in a boy, æt. 14, who was bowling a cricket-ball when he felt something give way at his collar bone. When seen the inner end of the clavicle was unduly prominent and presented a sharp edge beneath the skin, between which and the suprasternal notch a thin lamella of bone could be felt, quite unlike the smooth end of the bone covered with cartilage. The bone fell into place on laying the patient down, and was kept *in sitû* by means of a plaster-of-Paris bandage.

Dislocation of the Scapula

Dislocation of scapula or dislocation of acromial end of clavicle.

was formerly called dislocation of the acromial end of the clavicle; but as the clavicle is a fixed point, it seems only consistent with common sense, although not with custom, to follow Skey, Maclise, and Flower, and call what have hitherto been described as *dislocations of the acromial end of the clavicle*, dislocations of the scapula.

Causes.

In the more usual form of this accident, the acromion process of the scapula is forced *beneath* the clavicle. In rare cases, it may be received *above* it. Both are commonly caused by direct violence to the shoulder.

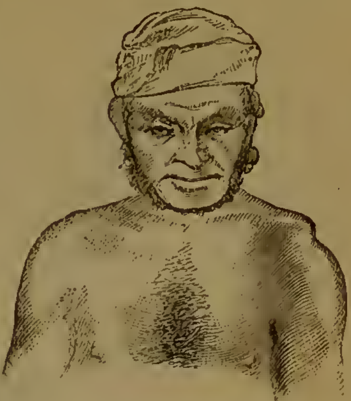
Symptoms.

The *symptoms* are well marked in both forms; the falling of the shoulder and projection upwards of the acromial end of the clavicle in one (Fig. 433), and the projection upwards of the acromion process of the scapula in the other, prevent any mistake being made.

Treatment.—In the dislocation of the scapula downwards, the aim of the Surgeon is to raise the scapula with the arm and depress the clavicle, which is best done by drawing the elbow well backwards, and applying a pad over the clavicle; the pad and elbow being fixed in position by means of a belt or plaster-of-Paris bandage passed over the clavicle and round the elbow. The belt presses the clavicle downwards, and raises the shoulder and arm upwards.

The parts fall into position at times when the patient assumes the horizontal posture, and when this is the case, and the position can be maintained for two or three weeks, it is well to adopt it. At others a pad fixed over the clavicle by means of strapping, or a bandage passed between the axilla, will suffice; but the Surgeon recognising the special wants of the case, must adapt his means to meet them in the best possible way. Good movements of the arm are, as a rule, acquired in time after either of these accidents.

FIG. 433.



Dislocation of the scapula downwards. Mr. Poland's case.

Dislocations of the Humerus

form at least half of all dislocations, and a sufficient explanation of this fact is to be found in the globular form of the head of the humerus, the shallowness of the glenoid cavity, the free movement of the articulation, and its liability to direct and indirect injury.

Statistics.

In 40 out of 60 consecutive cases, or in two thirds of them, I found a direct blow upon the shoulder was the cause of the accident, while in the exceptional cases, a fall upon the extended arm or elbow, or a forcible dragging backwards of the arm, was the assigned cause. The accident is rare in childhood, although I have seen an instance of it at the age of 13; while Flower and Hulke have recorded a case in an infant 14 days old. Two thirds of the cases are found in men between 50 and 70 years of age, it being comparatively rare in women and in young adult life. I have, however, treated one in a man aged 75.

Analysis of 60 *consecutive cases.*

Out of 60 cases, 31 were described as *subglenoid*, or downwards; 25 *subcoracoid*, or forwards; and 4 *subspinous*, or backwards. 49 were in males, and 11 in females. I am disposed to think that many of the cases called subglenoid were subcoracoid.

4 were in subjects under 20 years of age.
17 „ „ between 21 „ and 50.
38 „ „ „ 51 „ „ 70.
1 aged 75.

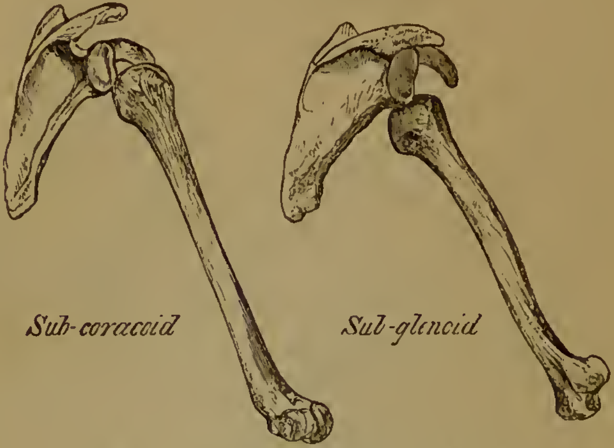
The three varieties.

The head of the humerus may be dislocated—1. *Downwards—subglenoid.* 2. *Forwards—subcoracoid.* 3. *Backwards—subspinous.* When the coracoid process has been broken off, the head of the humerus may be displaced over the root of the former; two or three such cases being on record. The supracoracoid and *subclavicular* dislocations are very rare.

Subcoracoid dislocation.

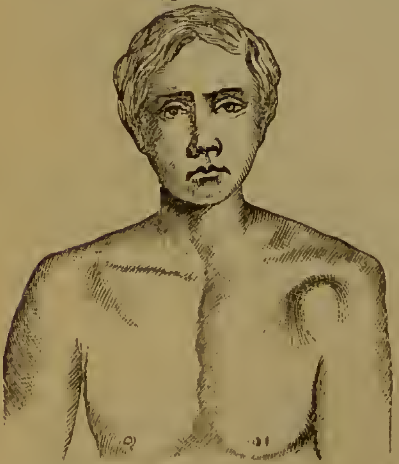
Subcoracoid.—This is without doubt the most common form of dislocation. Flower has shown ('Path. Soc.,' vol. xii), that 31 out of the 41 specimens of dislocation of the shoulder-joint found in the London Museums belong to this class. In it the head of the humerus rests on the anterior lip of the glenoid cavity beneath the coracoid process, or even more forwards, the completeness of this dislocation turning upon the amount of laceration of the attachment of the posterior scapular muscles. When they are completely torn through at their insertion into the great tuberosity of the humerus, or the tuberosity is torn off, the head of the bone will be more forward than when they are only stretched or partially divided. Many of the cases described by Sir A. Cooper as dislocation downwards, or as partial dislocation, were doubtless of this kind; and many others recorded as examples of subclavicular are nothing more than specimens of this variety (Fig. 434).

Fig. 434.



From Mr. Flower's models, Middlesex Hosp. Mus.

Fig. 435.



Subcoracoid dislocation of head of humerus. Drawing 27^{45}.

Symptoms of the subcoracoid variety.

Symptoms.—The symptoms of this form of dislocation, in their general character, are the same as in most others, such as inability to move the arm, immobility and pain often passing down some nerve-trunk, and aggravated by movement. On looking at the part, and comparing the injured with the sound side before swelling has appeared, some striking points will be observed, such as flattening of the deltoid, prominence of the acromion, and a depression beneath it. Extra prominence will also be seen below the coracoid process, from the head of the bone pushing forward the pectoral muscle (Fig. 435); from behind, too, there will be some flattening of the shoulder. There will be little or no lengthening of the limb, but the elbow will be found projecting more or less from the side; the movements of the forearm will be perfect. On manipulating the shoulder, the head of the bone will be felt beneath the pectoral muscle in front of the scapula, and from the elbow it will be made to move.

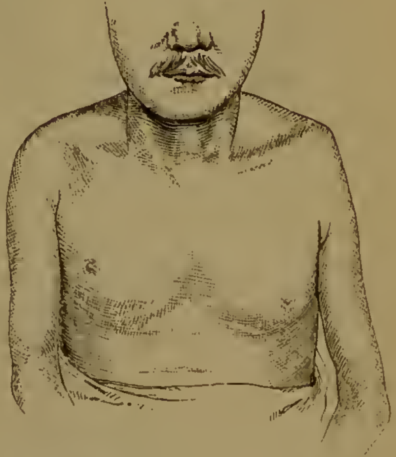
Subglenoid dislocation.

Dislocation downwards or subglenoid—although usually given as the most common—is probably second in frequency to the subcoracoid just described. Flower asserts that not one in ten of all dislocations of the humerus can properly be called subglenoid. In it the head of the bone rests below the glenoid fossa (Fig. 434), the rent in the capsule being at its inferior instead of its anterior border, and the soft parts mechanically interfering with the natural tendency of the deltoid, coraco-brachialis, and biceps, to draw the head of the humerus upwards towards the coracoid process.

Symptoms.

Symptoms.—The most constant are, immobility of the arm, as well as inability to move it without pain, with a greater separation of the elbow from the side, a more marked flattening of the shoulder, greater depression beneath and extra prominence of the acromion than are met with in the subcoracoid variety. The most typical, however, are a depression of the anterior fold of the axilla from a drawing down of its attachment; a falling of the breast, as indicated by a lower position of the nipple; the marked presence of the head of the bone in the axilla; the separation of the coracoid process and the head of the malplaced bone by a space of one to two inches (Fig. 436); and a clear elongation of the arm for one and a half inches.

FIG. 436.



Subglenoid dislocation of sixteen weeks' standing, taken from a man æt. 56, showing depression of the anterior fold of the axilla, falling of the breast, and elongation of arm.

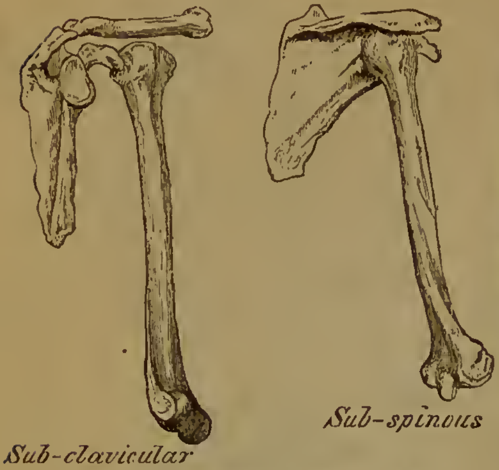
Hulke describes ('Holmes's System,' vol. i, ed. 3rd, p. 978) two rare examples of a variety of subglenoid dislocation, which he saw in the practice of the late Sir W. Fergusson. In both the arm was strongly *abducted and raised*, the elevation being so great as to make one patient seek support of the arm by grasping the end of a stick raised above his vertex; whilst the other rested his hand on the top of his head. In neither could reduction be effected.

Dislocation Backwards or Subspinous.

Subspinous dislocation.

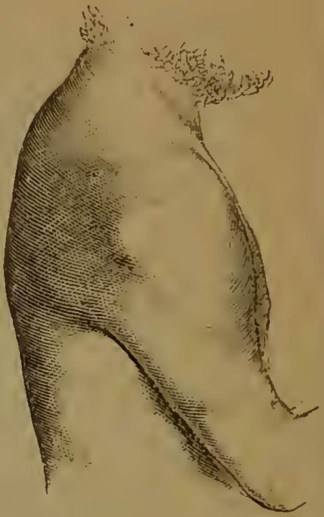
This is next in rarity to the last, and in it the head of the bone rests beneath the spine of the scapula or base of the acromion (Fig. 437); the latter position being a less complete luxation than the former, and more common. It corresponds to Malgaigne's "subacromial" variety, this completeness of the dislocation depending upon the amount of laceration of the muscles attached to the bone, and more particularly of the subscapularis.

FIG. 437.



From Flower's models, Middlesex Hospital.

FIG. 438.



Subspinous dislocation of head of humerus. Taken from life.

Symptoms.

The *symptoms* of this accident are very marked. Looking at the shoulder in front, there will be the flattening of the deltoid and prominence of the acromium as usual, but there will be a marked flattening if not depression of the soft parts below the coracoid and acromion processes. The elbow, instead of being fixed away from the side, will be drawn to it and forwards, the forearm generally pointing outwards. The back view, however, is the most typical, the head of the bone covered with muscles and soft parts forming a prominent feature in the case (Fig. 438). I had a patient under observation about thirty years of age, who could at will dislocate her shoulder in this direction by muscular action. In this dislocation the limb is said to be slightly longer than normal, but I have not found it so.

On subclavicular dislocations.

Subclavicular dislocations, in which the head of the humerus rests below the clavicle on the sternal side of the coracoid process, are exceedingly rare (Fig. 437). I have never seen a complete example. Malgaigne informs us that in it the arm is pressed against the chest with the elbow slightly removed from the side, the head of the bone being felt and seen in its abnormal position, and the shaft instead of the head of the humerus felt in the axilla. The bulk of cases recorded as of the subclavicular kind are probably subcoracoid.

The supracoracoid dislocation.

The supracoracoid dislocation is a mixed form of accident, as it is secondary to a fracture of the coracoid process. Malgaigne has recorded an example, and Holmes, in the 'Med.-Chir. Trans.,' vol. xli, a second, with an account of the dissection of the case, the preparation being in St. George's Museum. He also describes a third which occurred in the practice of Sir P. Hewett.

Important point in the diagnosis of these dislocations.

Some points in diagnosis remain to be told, and the most important was pointed out by the late Mr. T. Callaway in his excellent Jacksonian Prize Essay for 1849, which is: "*That in taking the vertical circumference of any shoulder in which dislocation exists by means of a tape carried over the acromion and under the axilla, an increase of about two inches over the sound side is an invariable concomitant.*" He should have added, however, that this test is only applicable to recent cases, and not to such as show muscular atrophy. The same author also shows, how elongation of the limb does not take place, at any rate, to any extent; the different accounts given by authors on this point depending upon the fact, that they are content with optical rather than actual measurement. Professor Dugas, of Georgia, has also pointed out ('Southern Med. and Surg. Journal,' 1856) a sign of dislocation of the shoulder-joint that merits more notice than it has received, and I am indebted to Dr. W Briggs, of Nashville, for calling my attention to it. It is based upon the physical fact, *that in consequence of the rotundity of the thoracic walls, it is impossible for both ends of the humerus to touch them at the same time.* "If the fingers, therefore, of the injured limb can be placed by the patient, or by the Surgeon, upon the sound shoulder while the elbow touches the thorax, a condition that obtains in the normal condition of the joint, there can be no dislocation. And if this cannot be done there *must* be one, for no other injury than a dislocation can induce this physical impossibility." Dr. F. Hamilton has likewise shown ('Lond. Med. Rec.,' April, 1875) how, in a dislocation, a rule will touch, at the same time, the acromion process and the elbow of the injured side, a condition that cannot exist in health.

Dugas's guide to diagnosis.

Dislocation associated with fracture.

It sometimes happens, that the head of the bone after its apparent reduction, fails to remain in position and falls out again; and when this occurs, it becomes a question whether some part of the glenoid cavity is fractured, or some other fracture exists. I have recently seen a case of dislocation of the head of the humerus forwards and downwards, in which a portion of the glenoid cavity was broken off and displaced downwards, associated with severe injury to the radio-spiral nerve. In children or young persons under twenty-one, the upper epiphysis of the humerus may be separated, or rather, the shaft of the humerus may be displaced off the epiphysis, which retains its normal position, and, under these circumstances, the arm should be most carefully manipulated under chloroform, to make the diagnosis sure. In exceptional cases, however, this slipping out again is not to be explained by these complications; for, in the case of a man æt. 75, who had a dislocation backwards, the head of the bone could not be kept in position till the muscles began to act after the effects of the chloroform had subsided, and I had to hold the bone in place till the patient recovered, and the muscles acted naturally.

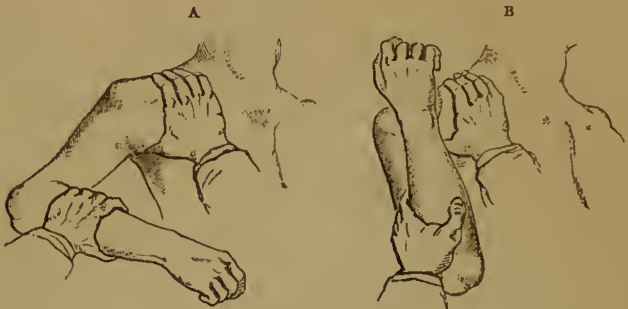
Mistaken for displacement oft epiphysis.

On the treatment of dislocation of the humerus.

TREATMENT.—The use of anæsthetics has completely revolutionised the treatment of dislocations, and, at the present day, nothing can usually be simpler than the reduction of a dislocation of the shoulder, and what was formerly called reduction by *stratagem* is now the rule. "If you can get a person off his guard," wrote Abernethy, "you have first to put your hand up to the head of the bone, depress the elbow, and it will sometimes succeed in putting it in;" and the modern Surgeon, in describing the reduction of dislocations by *manipulation,* might use the same language. To reduce a dislocated humerus by *manipulation,* an anæsthetic is essential, and when the patient is *fully* under its influence as well as in the horizontal position, the Surgeon should grasp the shoulder with one hand and the flexed elbow with the other (Fig. 439, A). When the dislocation is subglenoid or subcoracoid, the thumb

Mode of reduction by manipulation.

FIG. 439.



Extension, adduction and rotation outwards.

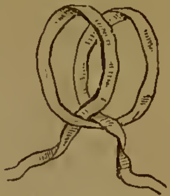
of the Surgeon may be placed over the head of the bone, and the fingers over the spine of the scapula, the thumb acting as a fulcrum; with the other hand the flexed elbow should be drawn from the side and extension made, some slight rotatory movement outwards being employed. When extension has been carried to its full extent, the elbow should then be raised and the arm made to describe a semicircle in the direction of the sternum and the face, and then suddenly brought down to the side of the thorax, the head of the humerus at the same time being rotated inwards. The thumb of the opposite hand should give the right direction to the head of the bone. (Fig. 439, B.) Should the first attempt fail, a second may succeed, or possibly a third. In the majority of dislocations of the shoulder, this method will succeed. In Philadelphia, this practice is known as H. Smith's method. In the dislocation backwards or subspinous, the same method will suffice, but in that case the head of the bone being behind the glenoid cavity, requires pushing forwards. Under such circumstances, the Surgeon should stand slightly behind the patient with one hand grasping the axilla with the thumb behind, and with the other the elbow, making extension; reduction may then be effected by drawing the elbow backwards and rotating the bone. By these means, I easily reduced an interesting case of dislocation backwards (subspinous) complicated with fracture of the ribs of the same side and of the opposite clavicle. When these means fail, or when chloroform is not at hand, reduction by means of extension with the heel in the axilla should be employed, the Surgeon with his unbooted heel pressing upon the head of the humerus or lower border of the axilla, and with his hand grasping the forearm of the misplaced limb, and making steady extension; some slight rotatory movement often facilitates reduction. The head of the bone usually slips into its place with a perceptible jerk, and the moment this is felt, all extension should be stopped.

Extension by heel in axilla.

To facilitate extension, the clove-hitch (Fig. 440) may be employed; and, instead of the heel, Mr. Skey's well-padded iron knob.

Mr. W. F. Teevan informs me that he has known the third rib to be fractured in the attempt to reduce a dislocation of the head of the humerus with the foot in the axilla.

FIG. 440.



Clove-hitch.

Hulke's plan.

If the humerus still resists, the following plan, writes Hulke ('Holmes's Surgery,' vol. i, 3rd Ed.), "which I have never known to fail in a recent dislocation, may be tried. The patient is seated in a high chair, which is placed about two feet from the post of an open doorway; the Surgeon, having his back against the doorpost, places one foot upon the side of the chair, and with his knee presses into the axilla, and with both hands upon the shoulder, steadies the patient's body; a jack-towel is then fixed by a clove-hitch knot to the patient's arm, just above the elbow, and by its means two or three assistants, placed on the other side of the doorway, make steady extension horizontally outwards."

This is only a modification of Sir A. Cooper's plan of bending the extended arm over the knee, placed in the axilla with the patient sitting, using the humerus as a lever; and is, doubtless, a good one.

Kocher's method.

In 1870, Kocher, of Bern ('Berlin. klin.. Woch.,' No. 9, 1870), introduced the following new and simple method of reducing subcoracoid dislocations which has been much and successfully practised at Guy's.

With the patient sitting, the Surgeon grasps the elbow of the affected limb with the forearm flexed at a right angle, presses it firmly to the side of the patient's chest, and rotates the flexed forearm and arm outwards as far as they will go, that is, until firm resistance is experienced. He then with the arm still rotated outwards carries the elbow forwards and inwards over but away from the chest towards the median line of the body, and suddenly rotates the arm inwards, carrying the hand of the affected limb by this movement towards the sound shoulder. By this last movement the head of the brim is replaced in the glenoid cavity.

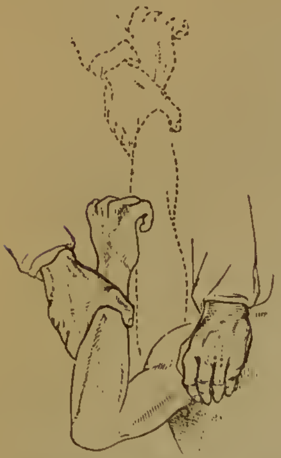
Kelly's method.

Mr. J. E. Kelly, of Dublin, also recommends a method of reduction which in his and his colleagues' hands has proved successful in twenty-seven cases. In it the patient should be placed on his back at the edge of a couch, lower by three inches than the great trochanter of the operator. "The operator places the injured arm at right angles to the body, and standing against it, with his side to the patient and his hip pressed firmly, but not roughly, into the axilla, he folds the arm and hand of the patient closely round his pelvis and fixes the hand firmly by pressing it against the crest of his ilium. The second step, during which the reduction is affected, is very simple, consisting merely of a rotation, or version of the Surgeon's body outwards away from the patient, with a force and rapidity which necessarily vary with the peculiarity of the dislocation; some yielding most readily to a sudden and powerful effort, and others to gentle and gradually increasing traction." ('Dublin Journal of Med. Soc.,' September, 1882.)

Extension upwards.

Should these means fail, success may be secured by drawing the arm vertically upwards, as practised by White, of Manchester, in 1764, and recently advocated by Mr. Lowe, of Burton-on-Trent ('St. Barth. Rep.,' 1870). In 1864, I succeeded by these means in the case of a subglenoid dislocation of one month's standing, in a man æt. 64, the method of manipulation and extension having failed; and again, more recently, in a similar case of twenty-four hours' standing, in a gentleman, æt. 30, when every other means had proved unsuccessful (Fig. 441). Mr. Lowe places his patient in a sitting posture on the floor, and then stands behind him on a sofa forcibly extending the dislocated arm upwards, the scapula being kept fixed by the Surgeon's foot. In all cases, the extension should be gradual and steady, the counter-extension effective; no jerking or great force should be allowed; pulleys are to be looked upon as dangerous appliances; with the use of anæsthetics they should be abandoned. In recent dislocations they are never needed; and in the old, adhesions should be broken through by forcible rotation and flexion of a joint rather than extension.

Fig. 441.



Reduction by extension of arm upwards.

Extension forwards is at times beneficial. It proved successful in my hands in a case of subspinous dislocation of three weeks' standing in a man æt. 75.

Cock's method.

In a neglected dislocation of twenty-five days' standing, Mr. Cock succeeded in 1859 (*vide* author 'On Diseases and Injuries of Joints,' 1859) by the following plan, all other means having failed:—"An air-pad, made of vulcanised india rubber, was placed in the axilla, and the arm firmly bandaged to the side, the air-pad thus being made to exert a powerful outward pressure upon the head of the bone. Upon removing the bandage upon the third day, the head of the bone was found to have returned to its natural position."

Difficulties when chloroform not used.

Without anæsthetics, obstacles to the reduction of a dislocation of the shoulder are muscular spasm, and the difficulty of replacing the head of the bone through the rent in its capsular ligament. With them the resistance of the muscles is an element which has not to be considered, the second one alone existing. In old dislocations, the presence of adhesions is an extra element of difficulty.

After-treatment.

After the reduction of a dislocation the arm should be bound to the side for a week, and kept at rest for a fortnight or more, with the object of giving time for the lacerated or injured parts to repair and recover their power. All violent exertion should be forbidden, and nothing more than passive motion should be sanctioned for several months.

Paralysis as result.

It happens at times that the trunks of the nerves are so injured as to give rise to paralysis of the muscles supplied by them. I have seen, in one case, the parts supplied by the ulnar nerve permanently paralysed; and in another those supplied by the musculo-spiral. It is by no means uncommon to find the circumflex nerve so injured as to be followed by a most complete wasting of the deltoid muscle. In many cases, however, in which paralysis follows dislocation, recovery may

May be recovered from.

ensue, and in a very marked example I saw in 1874, in which paralysis of all the parts supplied by the radio-spiral nerve was most complete, recovery took place in fifteen months.

Expediency of reducing old dislocations.

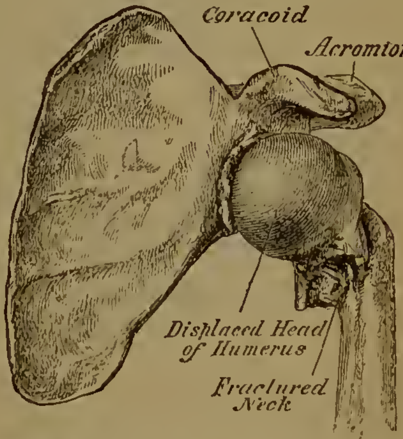
In neglected dislocation of the shoulder it is always a difficult question to decide as to the expediency of attempting reduction. Sir A. Cooper used to say, that after twelve weeks' rest an attempt should not be made, and, in a certain sense, such an opinion is correct; but there are many cases of less standing in which the attempt would be wrong, and some few of much longer standing in which it would be right.

Where good movement exists after twelve weeks there is little need for the attempt, unless under exceptional conditions. When bad movement exists, or none at all, the attempt may be made, for cases are on record in which reduction has been effected after a year or more.

Fracture with dislocation of head of humerus.

Fracture and Dislocation of the Head of the Humerus.—Dislocation of the head of the humerus is sometimes associated with fracture of the neck of the bone. It is, as a rule, caused by a direct fall or blow upon the shoulder, and it is probable that the dislocation occurs first, and the fracture follows. I have seen two undoubted examples of the injury. In one, a boy, æt. 16, the head of the bone was dislocated backwards beneath the spine of the scapula, and in the second, a man, beneath the coracoid process. When the dislocation can be reduced at once, as it may by means of an anæsthetic, so much the better. When it cannot the fracture must be treated, and the dislocation left alone, good movement at times being the result. In Fig. 442 such a complication existed. The preparation was taken from a gentleman, æt. 64, three months after the injury, before union had taken place at the seat of fracture.

Fig. 442.



Dislocation of the head of the humerus associated with fracture. Prep. 1114^{30}, Guy's Hosp. Mus.

It must be remembered that cases of fracture of the humerus about its tuberosities, when united, often simulate those of dislocation.

Compound dislocations of the shoulder.

Compound dislocations of the shoulder are grave accidents, and when the soft parts have been much injured the best plan is probably to resect the head of the bone, although when the wound is limited or clean and reduction easy it may be right to treat the case as one of wounded joint.

On dislocations of the elbow.

Dislocation of the Elbow.

This accident is most common in early life, and according to the Middlesex Hospital table ('Holmes's Syst.,' vol. i) more than half of the cases occurred in boys between the ages of five and fifteen. Dr. Hamilton found 19 in children under fourteen years of age out of 33 cases. At Guy's these proportions are not quite so large, for out of 13 cases 6 were in subjects between ten and twenty, 3 between twenty and thirty, 3 between thirty and forty, and 1 between forty and fifty. In only one case was the subject a woman.

Varieties.

Both bones may be displaced *backwards, outwards, inwards,* or *forwards,* backwards and outwards, or backwards and inwards. The *ulna* may be displaced backwards alone, the radius maintaining its natural position; and the head of the *radius* may be thrown forwards or backwards.

Conditions.

These dislocations may be more or less complete, simple or compound; uncomplicated, or complicated with fracture of one or more of the bones entering into the formation of the joint, or with fracture or displacement of an epiphysis.

Frequency of the several kinds.

In point of frequency, dislocation of both bones backwards is the most common, the other dislocations of both bones occurring in the order above given; dislocation forwards being so rare that without a fracture its existence was doubted by Sir A. Cooper, but Velpeau and Canton have each recorded undoubted examples.

The force required to produce any one of these injuries is severe. It is generally exerted directly upon the elbow, or indirectly upon the hand, either by a fall or twist. To admit of any dislocation, there must of necessity be much laceration of the ligaments.

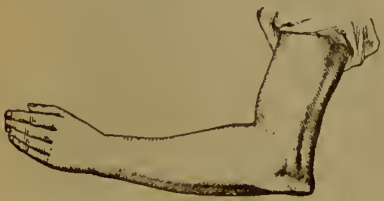
Symptoms and diagnosis of dislocation of elbow.

Symptoms and Diagnosis.

These accidents are not difficult to diagnose when they are seen at an early period of their existence, though after the lapse of some hours great difficulty may be experienced owing to the swelling masking the points of bone, and rendering it difficult to make out their relative positions.

The injured joint should always be carefully examined, each point of bone felt for, and its relative position with other points compared with those of the sound limb. In no cases can the Surgeon derive greater assistance or feel more forcibly the value of this rule than in dislocations of the elbow. The student should accustom himself to the manipulation of healthy joints, and learn where to place his finger upon the different prominences and depressions; and, having learned the normal conditions, he will find usually but little difficulty in discovering when a displacement has occurred.

Fig. 443.



Dislocation of radius and ulna backwards. From Sir A. Cooper.

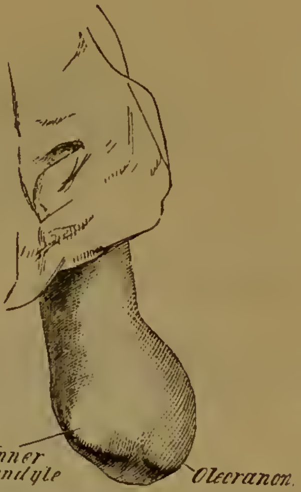
Both bones backwards.

When both bones are dislocated *backwards* (Fig. 443), the forearm is partially flexed and the hand slightly pronated; the displaced bones project backwards, and make a prominent swelling with the tendon of the triceps, while the condyles of the humerus can readily be felt in front, pushing the artery and soft parts forward; the inner condyle of the humerus and the olecranon being far apart; and the great increase in the antero-posterior diameter of the joint seen at a glance. In thin subjects, the olecranon and the head of the radius can readily be felt in their abnormal position to one another, and the head of the latter bone made through the hand to rotate in its new situation.

Dislocation outwards.

In the dislocation of the bones *outwards,* the marked prominence of the inner condyle of the humerus as seen from behind is a typical feature (Fig. 444), and, with luxation of the same bones inwards, the external condyle is equally prominent.

FIG. 444.



Dislocation of the right radius and ulna outwards. Posterior view.

Dislocation forwards.

In the rare form of dislocation *forwards* (Fig. 445), the loss of the olecranon from its right position, the unusual prominence of the condyles of the humerus, and the marked elongation of the forearm, are the chief features.

Ulna thrown backwards.

In dislocation of the *ulna backwards*, the pronation and twisting inwards of the hand, the great shortening of the ulnar side of the forearm, and projection backwards of the olecranon, mark the nature of the accident.

Dislocation of head of radius.

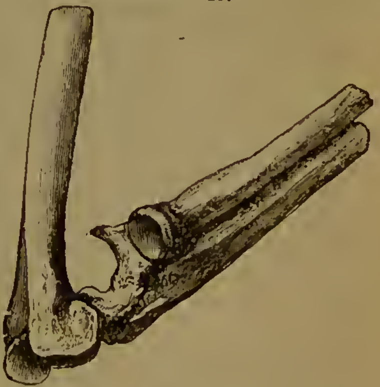
When the *head of the radius* is displaced alone forwards (Fig. 446) or backwards, its absence from its natural position, as well as its presence in an unnatural one, can usually be made out. In the forward dislocation the flexion of the joint is limited.

In the backward (Fig. 447), the movements may be complete; more commonly, however, they are limited.

Treatment of dislocation of elbow.

TREATMENT.—When the nature of the dislocation has been once recognised, there is little difficulty in its treatment, for with the patient anæsthetised and the muscles consequently paralysed, the reduction of any dislocation of the elbow by *manipulation*, or rather by moulding the joint into its right form, is readily effected. This may usually be done by the Surgeon's hands, pressure being applied according to the wants of the individual case, guided by the known anatomy of the part. Occasionally extension of the forearm is required, or the forcible bending of the forearm over the Surgeon's knee or thumb, but in the majority of early cases the joint may be moulded into its normal position.

FIG. 445.



Dislocation of radius and ulna forwards. Canton's case. 'Dub. Quart.,' Aug., 1860.

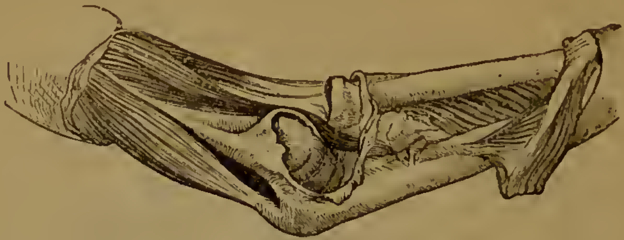
Mr. J. E. Kelly, of Dublin ('Dublin Journ. of Med. Sci.,' July, 1883), describes a method of reduction in dislocations at the elbow-joint worthy of consideration, in which the Surgeon sitting on a table, fixes the patient's humerus beneath one thigh and extends with his hands the forearm raised between them.

When some weeks have been allowed to pass without reduction, considerable force may be required to break down the adhesions, forcible flexion and extension being then applicable.

Attempts at reduction in old dislocations.

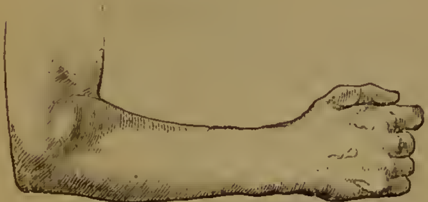
Up to two months, any dislocation of the elbow may be reduced, or rather an attempt at reduction may be made. After that date when useful movement has become possible, the attempt had better not be entertained. When no movement exists, it is, however, justifiable, but no definite rule can be laid down on this point, since each case must be judged upon its own merits. I have reduced after nine weeks, a dislocation of the bones of the forearm backwards, with an excellent result, and have failed after five. What would be justifiable under some circumstances would be unjustifiable in others, the age of the patient, his position or occupation, and necessities, having as great an influence in guiding the Surgeon as the time that has elapsed after the accident, and the amount of useful movement in the joint.

FIG. 446.



Dislocation of the radius forwards. Drawing 27^{80}, Guy's Hospital. From dissection. Mr. Hilton's case

FIG. 447.



Dislocation of the head of the radius backwards.

When both bones are displaced, or the ulna alone, the Surgeon should grasp the forearm as a whole. When the radius is the bone displaced, the extending force should be applied from the hand.

After-treatment.

After the reduction of the dislocation, the arm should be kept in a splint and cold lotion or ice applied, according to the amount of inflammation that ensues. When little inflammation follows, passive movement may be allowed in about ten days or a fortnight. After the reduction of a dislocation of the head of the radius forwards, there is usually great difficulty experienced in keeping the bone in its position. To effect this I have found the forced flexion of the forearm the best, the wrist and forearm being bound by means of a bandage to the arm. In a recent case the benefit of this practice was well displayed.

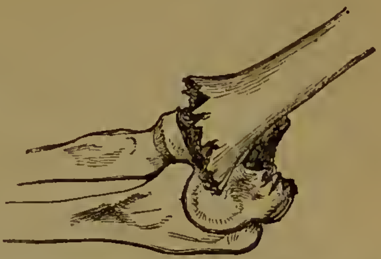
After reducing old dislocations.

When reduction of a neglected dislocation has been effected, it is wise to fix the elbow on an angular splint for ten days or a fortnight and to apply cold water, and, after all inflammatory action has subsided, to allow of passive or, possibly, forcible movements, as a stiff elbow-joint is a misfortune of no mean importance, and to prevent it measures may be employed which, under other circumstances, might be considered rash. In neglected cases, where reduction is beyond all hope, the Surgeon may use a considerable amount of force to flex the forearm to a right angle, in which position it should be fixed.

Compound dislocation of elbow.

In *compound dislocation* of the elbow-joint where reduction is possible and the wound small, the case may be treated as one of wounded joint, viz. by splints and the application of ice, good hopes existing of a sound recovery being secured with movement. When the wound is large and the soft parts are materially injured, excision of the joint should be performed, the success attending this practice generally being very satisfactory. When the vessels and nerves are clearly so injured as to preclude the possibility of a useful limb being secured amputation may be required.

FIG. 448.



Displacement of the lower epiphysis of the humerus backwards. Hutchinson's case.

Separation of the lower epiphysis.

In all these dislocations of the elbow the Surgeon should be careful to ascertain that they are uncomplicated; that no fracture co-exists; or, what is more common in young subjects, that no displacement of the lower epiphysis of the humerus is present, such as is shown in Fig. 448. This can only be made out by a careful comparison of the sound and injured sides, and the appreciation of the crepitus of fracture, the crackling of effusion, and the semi-crepitating feel of a displaced epiphysis.

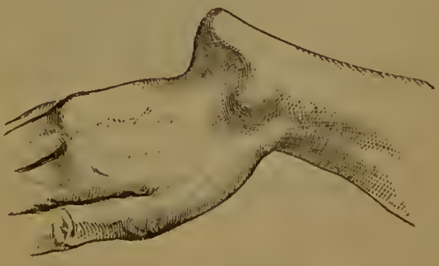
In June, 1881, I had a boy, æt. 9, under my care at Guy's, in whom the lower epiphysis of the humerus, with the bones of the forearm, was displaced backwards, and in which the anterior border of the diaphysis so injured the brachial artery as to occlude it. The displaced bones were restored to their position, and the arm bound with splints. The case did well, and in six weeks there was good movement in the joint and pulsation had returned in the radial though not in the brachial artery.

Dislocations of the Wrist.

Dislocations of the wrist.

These are exceedingly rare accidents, the majority of cases recorded as being of this nature being fractures of the lower end of the radius. What is known as Colles's fracture is the more common form of accident. Dupuytren pointed this out years ago, and the truth of the observation is now fairly recognised. When dislocation does occur the hand is displaced either *forwards* or *backwards*, the ends of the radius and ulna forming prominent points in the opposite positions and the styloid processes of the radius and ulna being recognisable points in a line with the shafts of

FIG. 449.



Dislocation of the hands forwards. Taken from a cast of Mr. Cadge's, copied from Erichsen's work.

Hand forwards.

the bones of the forearm (Fig. 449). This feature is important, for when the displacement of the hand is due to a fracture of the lower ends of the radius and ulna, the styloid processes will be in connection with the hand, instead of the shafts of the bones.

Treatment.

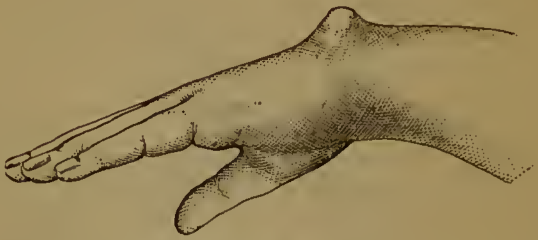
TREATMENT.—Reduction by manipulation is readily performed, extension of the hand and direct pressure upon the displaced bones, as a rule, effecting the Surgeon's purpose. The parts should be kept in position by an anterior and a posterior splint, extending to the flexure of the fingers. The splints should be removed, however, as soon as the parts have become firm, that is, in about three weeks; and passive movement of the fingers should be enforced.

Dislocation of lower end of radius.

Dislocation of the lower end of the radius with the hand may take place whenever the hand is forcibly pronated or supinated. When forcibly pronated, the ulna projects backwards, and the radius and hand forwards; when supinated, the reverse conditions are found to exist.

I have seen the former accident but once, and that case is figured 450. It was in a woman, æt. 56, who was admitted into my ward at Guy's for another affection. The dislocation had taken place some months previously, and had never been reduced. It was the result of a fall upon the dorsum of the hand. Pronation and supination of the hand were limited, and the ulna was fixed in its new position. The hand, although more pronated than natural, was very useful.

FIG. 450.



Dislocation of the hand and radius forwards off the lower end of the ulna.

Such dislocations are readily reduced by extending the hand and employing pressure to the displaced bones. After their reduction, anterior and posterior splints should be applied for two or three weeks, to prevent the bones slipping out of position, and to allow the ligaments time to unite. In the case figured no treatment was available.

Dislocation of carpal bones.

Of os magnum.

Dislocation of the carpal bones is an occasional though rare accident, and the displacement of the *os magnum* backwards, from a fall upon the flexed hand, is the most frequent form. I have known this to occur in a woman during the efforts of parturition in grasping a towel and forcibly bending the wrists, the bone being pressed out of its connection. When the accident occurs the prominent head of the bone on the dorsum of the wrist in a line with the metacarpal bone of the middle finger is too marked a feature to allow of there being any difficulty in the diagnosis. The bone, as a rule, is easily reduced by pressure, and kept in position by means of a pad. This pad must be maintained in position for many weeks after the accident, to allow time for the ligaments to consolidate.

Of pisiform.

Of semilunar.

South, in a note to his translation of Chelius, records a case in which the *pisiform bone* was displaced; while Fergusson and Erichsen describe others caused by over-action of the flexor carpi ulnaris. Erichsen also mentions a dislocation backwards of the *semilunar bone*, and in St. George's Hospital Museum there is a specimen of compound dislocation of this bone on both sides, occasioned by a fall from a height upon the hands, in which the bones were pressed out of a wound in front of the wrist.

Maisonneuve has recorded ('Mém de la Soc. de Chir.,' tome ii) a case, in which the second row of carpal bones was displaced backwards from the first; and Erichsen another, in which the metacarpal bones were displaced backwards from the carpus. These accidents are very rare.

Dislocation of the thumb.

Dislocation of the thumb at any of its joints is not unusual. The *metacarpal bone* may be displaced backwards or forwards from the trapezium, the former being the more common accident. This dislocation is frequently complicated with an oblique fracture through the base of the metacarpal bone. Sir A. Cooper described a dislocation inwards, but gave no case. Dr. F. Hamilton questions its occurrence.

Reduction of these dislocations by extension and local pressure is usually readily effected, the bones being kept in position by means of a pad and a good splint extending some inches above and below the displaced bone.

Dislocation of first phalanx from metacarpal bone.

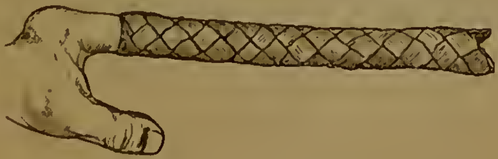
Dislocation of the first phalanx from the metacarpal bone is a recognised accident, the displacement *backwards* being the usual form. Dislocation *forwards* is a rare one. The first form is usually the result of a fall upon the distal end and palmar surface of the thumb, the head of the metacarpal bone projecting forwards, the base of the first phalanx backwards, and the extreme phalanx being flexed upon the first. The head of the metacarpal bone in some cases may be thrust forward through the capsule of the joint, and caught between the two heads of the flexor brevis muscle, whilst in others, as in one I have seen which was compound, the long extensor tendon of the thumb was hitched round the ulnar side of the base of the first phalanx, and thus prevented reduction, which was readily effected by forcible extension, adduction, and rotation.

Treatment and mode of reduction.

When difficulty in reduction.

In some cases, the reduction of this form of dislocation is effected with ease by simple extension, or, by the pressure of the Surgeon's thumb upon the displaced phalanx, and for the purpose of extension nothing equals in value the Indian toy called a "puzzle," or tube of plaited reed (Fig. 451). When this is not at hand, strips of strapping applied longitudinally to the distal digit and fixed by a circular piece will answer the purpose. In some instances all these means fail and

FIG. 451.



there is yet much obscurity as to the cause of the difficulty. The numerous muscles and tendons that surround the joint doubtless have a powerful influence, more particularly the two heads of the short flexor with the sesamoid bones, and, when the wound in the capsule is small, these muscles act more powerfully, the base of the displaced bone or the head of the metacarpal bone being held by these parts "as a button is fastened into a button hole." Under these circumstances, success may at times be achieved by flexing the metacarpal bone of the thumb to an extreme degree, rotating, and then suddenly extending the displaced phalanges; this manœuvre, as it were, freeing the displaced bone from the many tendons and ligaments that surround the joint, and that doubtless, at times, interfere with its reduction. I succeeded by this method in one case were every other had failed. My friend, the late Mr. Sells, of Guildford, informed me that he has with facility reduced several dislocations of this form by forcibly bending the thumb back, so as to tilt the base of the phalanx over the head of the flexed metacarpal bone and then extending it. Both these means have the effect of relaxing the short flexor muscle as pointed out by Prof. Fabbri. When all such means as have been mentioned have been unsuccessfully tried, the subcutaneous division of the tendons and ligaments that appear to prevent reduction has been practised with variable success; and when this fails, excision of the part has been employed. In a case of this kind of six months' standing, when the thumb was a useless member and the seat of pain, I excised the joint with excellent success, a movable articulation being secured with hardly any deformity.

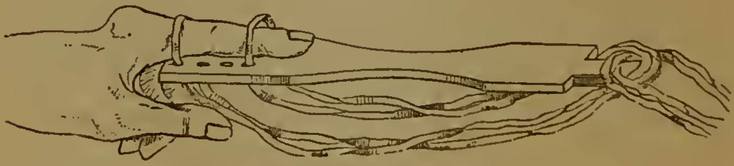
Excision.

When the bone is displaced *forwards*, it seems probable from the dissections of M. L. H. Farabeuf (Arch. Générales de Médicine, Sept., 1876), that the extensor tendons of the thumb stretched on the inner or outer side of the metacarpal bone is the cause of the difficulty in its reduction, and, under such circumstances, forced flexion of the thumb upon the palm aided by manipulation is generally enough to replace it.

Dislocation of ungual phalanx of thumb.

Dislocation of the ungual phalanx of the thumb may take place in either direction, forwards or backwards, the last being the more common, and the displaced bone being so small, difficulty is often felt in applying extension to it. The puzzle (Fig. 451) is the best thing to employ for the purpose, or Levis's apparatus (Fig. 452). At times pressure with the thumb upon the displaced bone or forcible flexion will succeed. Hamilton pithily advises "forced dorsal flexion in the case of the backward luxation, and forced palmar flexion in the case of the forward dislocation" (p. 634, ed. 3).

Fig. 452.



Dislocation of the phalanges.

Dislocation of the phalanges of the fingers, like those of the thumb, may occur in two directions, the backward being the more common. They are readily made out and easily reduced by extension, or flexion and then extension.

DISLOCATIONS OF THE LOWER EXTREMITIES.

Dislocations of the Hip.

Dislocations of the hip.

These are grave accidents and are found mostly in male adults, between 15 and 50 years of age, but occasionally in the young or old. The following analysis shows many of these points :—

Analysis of cases.

Out of 80 consecutive cases which have occurred at Guy's and in my own practice, 18 occurred in subjects under 20 years of age, the youngest being 5; 36 between the ages of 21 and 40; and 26 had passed that period; 69 were males, and 11 females; 41 were on the dorsum, 14 into the foramen ovale, 16 into the sciatic notch, and 9 on the os pubis.

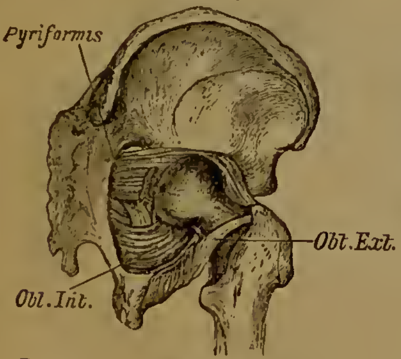
Mr. Powdrell ('Lancet,' 1868) has recorded a case in which the head of the femur was displaced into the foramen ovale at the age of six months, and reduced by manipulation. Erichsen has recorded another, of dislocation on the pubes, in a child a year and a half old. I have treated three cases of dislocation on the dorsum in boys æt. 5, and in a girl æt. 5½; but these are exceptions. On the other hand, dislocations may occur in the aged; Malgaigne has recorded five between the ages of 60 and 85, and my notes contain cases which occurred in men aged 61, 64, 65, and 76; but at this time of life fracture of the neck of the femur is more common.

Causes.

The accident is always the result of violence, no slight force being required to tear through the ligaments that hold and bind the head of the femur in its deep pelvic cup; indeed, were it not for the great leverage of the lower extremity, the accident would probably be a rarity. In exceptional instances, however, the bone is displaced with the slightest force. I have had a young man under my care whose femur had been dislocated a dozen times or more, the smallest twist in the limb causing its dislocation backwards.

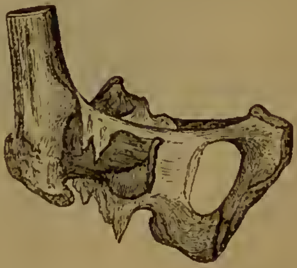
Congenital dislocations and displacements from disease are not included in this group.

Fig. 453.



Recent case of dorsal dislocation.

Fig. 453a.



Rent in capsule, with femur flexed.

From Mr. Morris's paper.

Varieties of dislocation of hip.

Dislocations from accident are of various forms, but the division made by Sir A. Cooper is, doubtless, practically the best, if we remember that varieties of each form or partial dislocations, are met with in practice; since there is good reason to believe that the head of the thigh-bone may rest at any point round its socket.

1. Dislocation *upwards* and *backwards*, on the dorsum ilii is the most common.

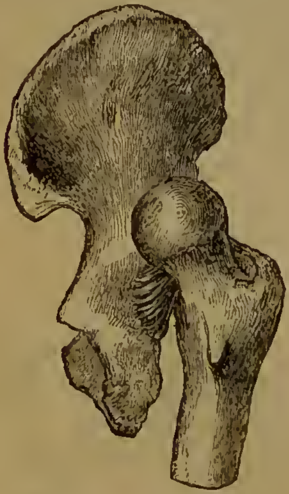
2. Dislocation *backwards*, towards the ischiatic or sciatic notch—a variety of the latter—stands third on the list as to frequency.

3. Dislocation *downwards* and inwards, into the foramen ovale stands second.

4. Dislocation *upwards* and *forwards*, upon the pubes, is about equal in frequency to that towards the sciatic notch.

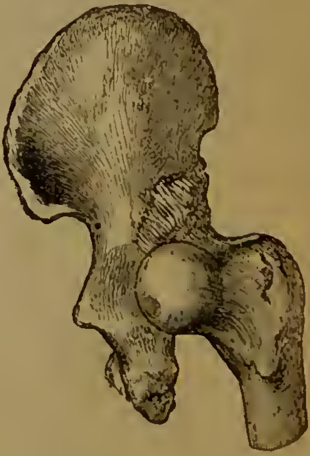
How formed. These several forms of dislocation depend much upon the degree of flexion or extension, and of inward or outward rotation of the thigh at the time of luxation. The head of the femur under most if not all circumstances, as demonstrated by Mr. Henry Morris in an able paper ('Med.-Chir. Trans.,' 1877), leaves the acetabulum, when the lower extremity is *ab*ducted, through a rent in the capsular ligament where it is the thinnest, viz. at the inner and lower side of the joint (Fig. 453A), the strong ilio and ischio-femoral ligaments situated on the anterior, outer, and posterior aspects of the joint and the shape of the acetabulum preventing displacement in any other position. With the limb abducted, however, the head of the femur is more than half out of the acetabulum, the ligamentum teres is quite loose and all the strong portion of the capsule is relaxed. Indeed Mr. Morris believes, that it is only in *ab*duction of the lower extremity that a simple dislocation of the head of the femur can possibly occur, and that a dislocation on to the dorsum ilii or towards the sciatic notch is due to the amount of *flexion* and rotation of the limb *inwards* at the moment of the accident, and dislocation on to the pubes to *extension* and rotation

FIG. 454.



Dislocation of the head of the femur on dorsum. (Backwards and upwards.)

FIG. 455.



Dislocation of the head of the femur backwards.

Taken from specimens in the Middlesex Hospital Museum, and prepared by Mr. Morris.

outwards. Also that the degree of *flexion* and rotation of the limb *inwards* determines in any particular instance whether the dislocation shall be dorsal or ischiatic, the latter variety occurring when flexion is carried to an extreme.

Direct dorsal dislocation can only be produced by immense violence and is often complicated with fracture of the acetabulum.

Condition of round ligament.

In all cases, the round ligament and capsule are torn across, the muscles about the joint being more or less lacerated.

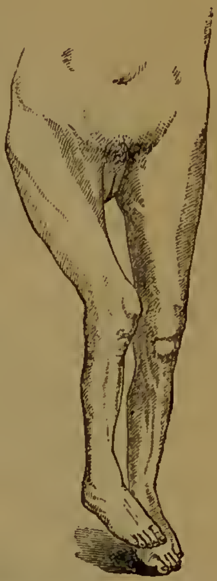
Dislocation on the dorsum.

Characters.

Dislocation on the dorsum ilii, or backwards and upwards, forms about half of all the cases of dislocation at this joint, and is usually produced by some twisting movement of the body or limb when the latter is abducted, or from a crushing weight received when in a stooping posture. It can be recognised by the following signs, viz. the flexed position of the thigh, the knee when the patient stands projecting in front of but above the other; the rotation inwards of the limb, the great toe resting on the instep of the opposite foot; the projection of the great trochanter and its approximation to the anterior superior spinous process of the ilium; the elevation of the fold of the buttock; the immobility of the limb, and the pain produced by any attempt to abduct or to extend it; and the marked shortening of the limb from an inch and a half to two and a half inches (Fig. 456).

In thin subjects, the head of the bone may be felt lying upon the dorsum ilii, and in all there will be an unnatural fulness of this part. Slight flexion and adduction will usually be borne, while patients may support the weight of the body on the injured limb, or even walk upon it.

FIG. 456.



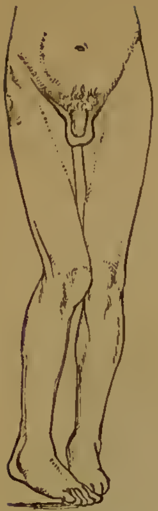
Dislocation backwards, on the dorsum. Drawing 30^{5}.

Dislocation into the ischiatic notch.

Character.

Dislocation backwards towards the ischiatic notch forms about a seventh of all cases and may be regarded as a variety of the one just described: indeed, Erichsen describes the two forms together as the ilio-sciatic. It is characterised by the same though less marked symptoms. There is less shortening, but if the patient be placed upon his back and the thigh be flexed upon the trunk at a right angle, then the knee of the dislocated limb will sink below that of the other side from one to two inches (Figs. 457*a*, 457*b*), the trochanter is drawn up and rotated forwards, but not to the same extent; and the head of the bone cannot be felt. To the eye, the limb assumes much the same position as in the last form, but there being less shortening the toes rest on the ball of the great toe of the opposite limb instead of on the instep (Fig. 457). Bigelow believes that this form of dislocation is due to the protrusion of the head of the bone below the tendon of the obturator internus muscle; whereas, in the former kind the bone is protruded above the tendon. In this, however, he is wrong, as Mr. Morris has shown that the head of the femur in *all* forms of dislocation makes its exit from the acetabulum below this tendon.

Fig. 457.



Dislocation into the sciatic notch. From Bigelow.

Fig. 457*a*.

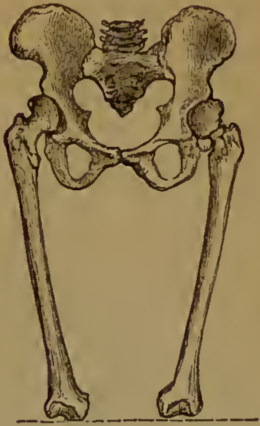


Fig. 457*a* shows position when the limbs are extended, the shortening being slight.

Fig. 457*b*.

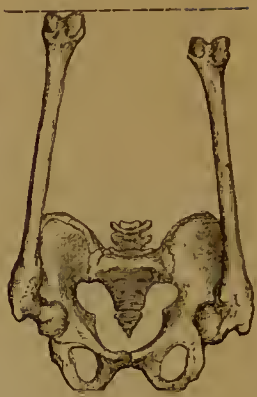


Fig. 457*b* shows the limbs raised to a right angle with the recumbent trunk, the shortening being very striking.

From paper by Dr. W. Dawson, of Ohio, who subsequently wrote that this test of dislocation had been suggested by O. H. Allis in 1874, 'Philadelphia Med. Times.'

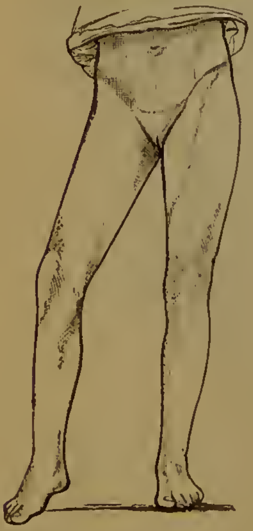
Dislocation into the foramen ovale.

Dislocation upon the foramen ovale or obturator foramen is a very striking accident. Sédillot, as well as Boyer, believe that it is the most common of all forms, but British and American Surgeons usually place it third on the list. In my own table it stands second. It is generally caused by some forced abduction of the knee or foot, the head of the bone being tilted inwards. In the case from which Fig. 458 was taken, it was caused by abduction of the knee, when the girl (æt. 14) was stepping out of an omnibus.

Characters.

It is characterised by the bent position of the body and the pointing of the foot forwards and slightly outwards; the approximation of the trochanter towards the mesial line and consequent flattening of the hip; hollowness below the anterior superior spinous process of the ilium; the absence of the gluteal fold, and the elongation of the limb from one to two inches. Any attempt at movement causes pain. The head of the bone can often be felt in its new position beneath the adductors (Fig. 459). The patient at times can, however, walk with such an injury.

Fig. 458.

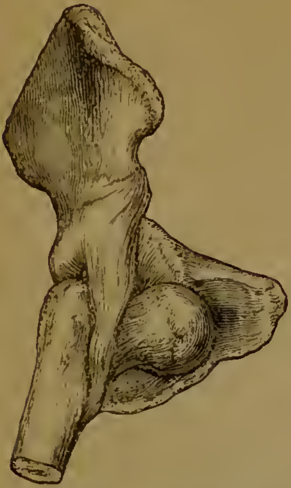


Dislocation into the foramen ovale. Taken from a girl æt. 14.

Dislocation upon the os pubis.

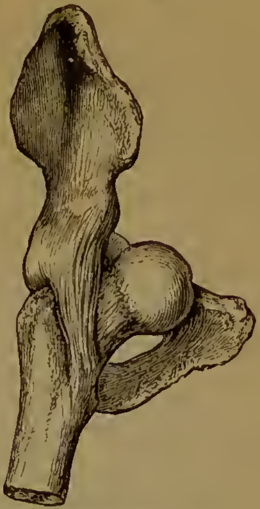
Dislocation upon the os pubis is the least common form of disloca-

FIG. 459.



Dislocation into foramen ovale.

FIG. 460.



Dislocation upon os pubis.

From preparations.

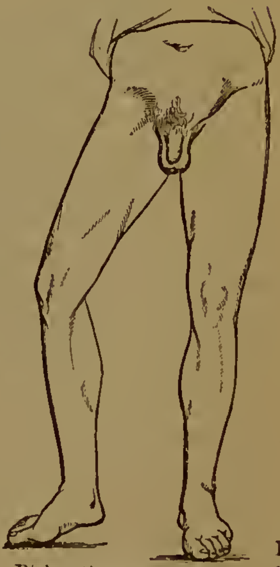
tion, and is due to forced extension and rotation outwards of the thigh, after dislocation by abduction, the pelvis being thrown forwards and the body bent backwards as the head of the femur is wrenched out of the socket and then drawn upwards.

Characters.

It is marked by eversion of the limb and foot and abduction; rotation backwards of the trochanter, and consequent flattening of this region. The head of the bone can usually also be felt, if not seen, as a projection upon the os pubis (Fig. 460) or on some part of the lip of the acetabulum. When thrown above the bone beneath Poupart's ligament, it forms a very prominent projection beneath or to the outer side of the femoral artery (Fig. 461).

When the head of the bone is thrown between the anterior superior and inferior spines of the ilium, or between the inferior spine and the acetabulum, the head of the bone will be felt in that position.

FIG. 461.



Dislocation upon os pubis. From Astley Cooper.

Diagnosis of dislocations of hip.

Diagnosis.—With reasonable care and attention to the special symptoms which characterise the different forms of dislocation, these ought readily to be made out, although certain fractures about the neck of the femur may present symptoms somewhat similar. I have seen two cases of impacted fracture of the neck of the thigh-bone with the foot inverted and the thigh flexed, presenting symptoms so similar to those of dislocation into the sciatic notch, that the diagnosis could not be made out till the patients were brought under the influence of chloroform, when, by gentle manipulation, the nature of the accident was discovered; the greater freedom with which the head of the bone could be made to rotate in the acetabulum, and the limp condition of the limb under chloroform in the case of fracture, forming a marked contrast to the immobility and permanent position of the thigh in dislocation. The late Mr. R. W. Smith (on 'Fracture,' 1850) records also a case of fracture of the neck of the femur which had been mistaken for dislocation.

Acetabulum may be chipped.

When in the adult the displacement recurs, after the apparent reduction of the bone and the extending force has been removed, the probabilities are, that the lip of the acetabulum has been broken off, or the head of the femur fractured (*vide* Birkett, 'Med.-Chir. Trans.,' vol. lii); and, when in a child, the separation of the head of the bone or upper epiphysis should be suspected; it being quite impossible under both these circumstances, to maintain the bone in position, except by means of a long splint or weight to keep up extension. In all cases of a doubtful nature, chloroform should be given for purposes of diagnosis, the Surgeon using the gentlest manipulation. The sudden loss of mobility, the rigidity of the limb, the absence of crepitus and other symptoms of fracture, with the positive signs of the injuries themselves, are sufficient to indicate the nature of the case. Nélaton's test for dislocation of the hip backwards is, however, excellent, and consists of a line drawn from the anterior superior spinous process of the ilium to the most prominent part of the tuberosity of the ischium. In a normal joint, the trochanter, in every position of the limb, merely touches the lower border of this line; but in all dislocations where the bone goes backward, it is found sometimes an inch above it.

Nélaton's test for dislocation.

Treatment of dislocations of hip.

TREATMENT.—Sir A. Cooper, with the surgeons of his day, considered the muscles about a joint as the chief agents in drawing a displaced bone into its abnormal position, and as forming the main obstacle to its reduction; and, as a consequence, they relied upon physical force in the form of pulleys and other complicated appliances, as the chief means by which this obstacle could be neutralised. The modern Surgeon with anæsthetics in his hands knows, that the muscular system has usually little or nothing to do with the difficulties that are met with in the reduction of a dislocation; that these are found in the ligaments and capsule; and that a large laceration in the capsule allows easy reduction, whereas difficulties must be experienced when the rent is small. With chloroform, therefore, all pulleys and mechanical appliances can be done away with—certainly in recent and probably in old cases. In my own opinion they are never required, for adhesions are more readily broken down by forced flexion and rotation than by simple extension, and if these fail no extending force will succeed. In dislocations of the hip, the reduction by flexion becomes, therefore, a reality and is one of the greatest improvements in modern surgery.

Flexion under chloroform.

In ilio-sciatic dislocations.

In the dislocations backwards, *ilio-sciatic*, the reduction by flexion is the correct method, adduction, circumflexion, abduction, and extension of the limb being subsequently and successively employed (Fig. 463). In dislocation into the foramen ovale the reduction by flexion is likewise good, with subsequent circumflexion inwards, and extension (Fig. 462).

In sub-pubic dislocations, the reduction by extension outwards and rotation is preferable.

Mode of reduction by flexion and manipulation.

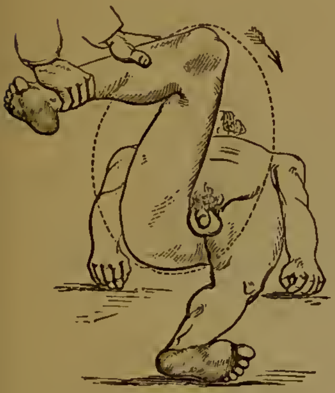
To carry out this reduction by flexion and manipulation, the patient should be placed on his back on a hard couch and thoroughly anæsthetised. The Surgeon should then grasp the ankle of the displaced limb with one hand, and the ham with the other, flexing the leg upon the thigh, and the thigh upon the pelvis, at the same time *lifting* the limb and adducting it towards the opposite side of the umbilicus. Having effected this movement, the Surgeon should, by a semicircular sweep outwards, suddenly extend the limb and bring it into a straight line with the body (Fig. 463). If one attempt fail, a second may be made, and in by far the majority of recent cases success will attend the effort. "If there is any single and best rule for reducing a recent dislocation of the hip," writes Bigelow ('Lancet,' June 15th, 1878), "it is to get the head of the femur directly below the socket by flexing the thigh at about a right angle, and then to lift or jerk it forcibly up into its place. This rule applies to all dislocations except the pubic. Flex and forcibly lift, and if this fail, flex and lift while abducting." No roughness should be used, gentle, well-directed manipulation being all that is called for, the leverage obtained through the femur being enormous. Some slight rotation of the limb outwards or inwards, according to the necessities of the case, at times facilitates reduction. Callender insists ('Lancet,' 1868), and I think wisely, upon the importance of *not fully abducting* or rolling the limb outwards, as, if this be done, the head of the bone is almost certain to roll past the acetabulum to its inner side; or, if an obturator dislocation is under treatment and the thigh is rotated inwards, the head of the femur will roll round to the ischiatic notch, just reversing the movement which takes place when an ischiatic dislocation is improperly manipulated. The object of the treatment is, to use the femur as a lever to raise the

Bigelow's rule.

Callender remarks.

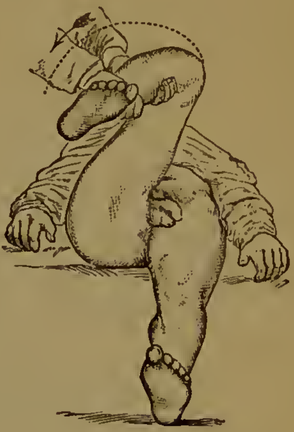
Reduction by manipulation.

Fig. 462.



In dislocation into the foramen ovale. From Bigelow.

Fig. 463.



In ilio-sciatic dislocation.

The object of the treatment.

head of the bone from its backward position, and allow the stretched muscles to act naturally and draw it into place, the act of flexion completely relaxing the strong ilio-femoral ligament. The Surgeon, with his knowledge of the way in which the head of the bone was driven through its capsule, using his best endeavours to make it retrace its steps, and employing his anatomical knowledge to press, elevate, or guide the malplaced bone into its normal position. The various movements adopted in reduction by manipulation, as well shown by Morris, serve to bring the head of the displaced femur down to the notch in the acetabulum by making it retrace the course it took in the process of dislocation, and then subsequently turning it back through the rent in the capsule by a rotation the reverse of that which occurred during dislocation. This method of reducing dislocations of the hip is known in France as Deprés' method, in America as Reid's. The former employed it in 1835 (*vide* Nélaton's 'Pathol. Chirurg.,' 1847), but Dr. H. Bigelow has proved that the credit of the method is really due to Nathan Smith, of New Hampshire (*vide* Memoirs, 1831). In a case of dislocation into the foramen ovale in a man, I failed in my first attempt by manipulation, but in the second I succeeded by the application of the slightest pressure upon the head of the bone; and in the case of the girl from whom Fig. 458 was taken the head of the bone slipped into its position by simply flexing the leg on the thigh and the thigh on the pelvis, with such gentle pressure as I was applying for a preliminary diagnosis.

Morris's views.

In one case of severe injury to the joint that came under my care, where the bone was displaced on the dorsum, on attempting its reduction by manipulation the head of the bone slipped with such facility round the acetabulum as to illustrate every typical form of dislocation, and several intermediate or partial forms. In this case, however, reduction was subsequently readily obtained by thoroughly flexing the thigh upon the pelvis, and *lifting* the head of the femur from its false position by extension forwards.

Size of rent in capsule.

When the rent in the capsule is small, difficulties may be felt in reducing the dislocation, but when large, little is usually experienced.

Exceptional cases of dislocation of hip.

At times reduction is thought to have been accomplished when redislocation appears after the limb has been left alone; and, under these circumstances, it is probable that the head of the bone had only partially been replaced through the rent in the capsule. In other cases of this kind which refuse to remain *in sitû*, there is reason to believe that the lip of the acetabulum has been fractured, or, in young subjects, that the head of the femur has separated at the epiphysial line of junction with the neck. Still, without these explanations, cases are met with in which it is quite impossible to keep the limb in position after its reduction. In some cases, the reduction of the dislocation occurs when the patient is in bed, by simple muscular movement. I have seen several. When reduction by flexion has failed or is inapplicable, that by extension should be employed, and in the pubic form of dislocation, no other should be used. It should be practised with the patient under the influence of an anæsthetic, and on his back, and as follows:—The pelvis should be fixed by a perineal band well padded and adjusted, and the limb extended in the line of its position to draw the head of the bone out of its bed. The Surgeon should then either elevate the bone to allow the muscles to act upon it or abduct, adduct,

When manipulation fails, extension is to be used.

or rotate inwards or outwards, according to the special want of the individual case. In some cases, the simple extension of the limb with the unbooted heel of the Surgeon placed firmly in the perinæum will answer every purpose.

Mode of using extension.

After the reduction of a dislocation, the legs should be fastened together, and no movement allowed for three weeks, and then only gentle movement, for if this rule be not attended to, redislocation may occur. In a case under my care of dislocation into the foramen ovale, in a young woman, after reduction had been effected, redislocation occurred on the tenth day, from crossing the leg over the opposite knee in attempting to cut the toe-nails of the affected limb.

After-treatment.

Splints are hardly called for in the majority of cases, although should secondary inflammation follow or much local mischief complicate the case, they should be applied, either with ice or hot fomentations, the Surgeon selecting the application that gives most relief.

Old dislocations, in a general sense, should be left alone, since in the hip, difficulties of reduction are always felt, and danger not rarely met with. During the first three weeks, reduction is rarely difficult, and may always be tried; indeed, within the month, good hopes attend the attempt. I have seen a dislocation on the dorsum reduced on the thirty-fifth day, with an excellent effect. Dr. H. Croly, of Dublin, told me, in 1879, of a case of dislocation on to the pubis, in which reduction was effected on the thirty-ninth day by manipulation, after an attempt with pulleys had failed. Success has, however, been recorded in exceptional cases up to the sixth or eighth week, or even after six months, but failure has more frequently followed the attempt. My colleague, Mr. Durham, in 1873, reduced one after the fifth month. Fergusson states that after three weeks he has never seen a successful attempt. Sir A. Cooper fixed eight weeks as the limit of time up to which the attempt should be made, and without the use of anæsthetics he was doubtless right. When reduction has failed, good movement may often be secured after the lapse of time. The dangers attending attempts at reduction are not theoretical. Inflammation and destruction of the joint are no infrequent consequences, and fracture of the bone has been recorded by many Surgeons. Dislocation of the knee or rupture of its ligaments has likewise taken place from the extension employed, and with a fatal result.

Old dislocations of the hip.

Dangers of attempting reduction in old cases.

When fracture of the femur is associated with *dislocation of the bone* the latter should, when possible, be reduced by manipulation. In 1860, I saw my colleague, Mr. Birkett, reduce with the greatest facility a dislocation of the head of the femur on the ramus of the pubis in a boy, æt. 12, when the femur was broken below the trochanter, the bone slipping into place on the application of gentle, well-directed force. Similar cases have been recorded by Bloxam and M. Etène.

Dislocation with fracture of femur.

If the reduction of the dislocation by these means has failed some hope remains that when the fracture has united a better success may be secured. Sir A. Cooper has related an example in which reduction, by means of extension, was effected five weeks after the accident, in a youth about seventeen.

Effects of Dislocation.—The sciatic nerve may be injured at times in a dislocation of the hip, and as a consequence paralysis may ensue. Morris shows in his paper how this complication is caused, while

Effects of dislocation of hip.

Maclise, in his illustrations, gives a drawing illustrating how the nerve may be stretched, and Hutchinson ('Med. Times,' 1866) recorded a case in which the paralysis was permanent.

Dislocations of the Patella.

Dislocations of the patella.

These are not common accidents, but seven occurred at Guy's in ten years; when they occur they are generally caused by muscular action, though at times by the application of direct force. They are most commonly met with *outwards*, occasionally *inwards*, and very rarely *edgeways*. When the ligamentum patellæ has been torn across the patella is drawn upwards, and authors have described this accident as dislocation *upwards*.

Dislocation outwards.

The dislocation *outwards* is usually seen in women in whom the femora have a more oblique inward direction than in most men; or in knock-kneed subjects, the bone resting flat on the outer condyle of the femur or on its outer edge; in the former case the outer edge of the patella, and in the latter the inner tilts forwards. The knee is usually slightly flexed; it looks broader and flatter, but the unnatural position of the cap marks the nature of the accident. In 1868 I saw this accident in a male child ten months old; the patella rested on the outer side of the condyle of the femur, and was readily reduced.

Dislocation inwards.

Dislocation *inwards* is very rare, and easily recognised. It is always due to direct violence to the outer border of the bone.

Both these accidents are attended with laceration of the synovial capsule.

Treatment of dislocation of the patella.

Treatment.—Reduction is readily effected, usually by raising the heel of the limb to relax the extensor muscles of the thigh, and manipulating the displaced bone into its position, the elevation of its depressed edge being generally enough to allow the muscles to restore it to its right place. A splint should then be applied, as well as a bag of ice for a few days till all inflammatory action has subsided, the knee being strapped up subsequently for a month or more, to give time for the ligaments to unite firmly. These dislocations, however, are very prone to recur on the slightest cause, and many patients are obliged to wear for life a firm leather knee-cap to guard against such a contingency.

Dislocation of the patella edgeways.

Dislocation of the bone *edgeways* is a very uncommon accident. I have seen only one such instance; and in it the patella appeared to show its articular facet inwards, its inner edge presenting forwards beneath the stretched skin. It was in a middle-aged woman, and the displacement was produced by a direct blow upon the knee from a fall off a chair. Mayo has recorded an instance in which the bone had turned almost round.

This dislocation is readily known by the peculiar appearance of the joint.

Treatment thereof.

Treatment.—In my own case reduction was effected with ease on raising the leg, and turning the patella into its right position with the fingers. Flower only succeeded on bending the knee after chloroform had been given. Cases have been recorded where reduction was impossible, even after the subcutaneous division of the tendon and ligament that is attached to it, and other rough means, but these were employed before chloroform was introduced, which must be their excuse. Under an anæsthetic it is probable that, by manipulation, the bone will usually be reduced, if not it had better be left alone. Some sudden muscular effort might be of service.

Dislocation of the Knee-joint.

Dislocation of the knee-joint.

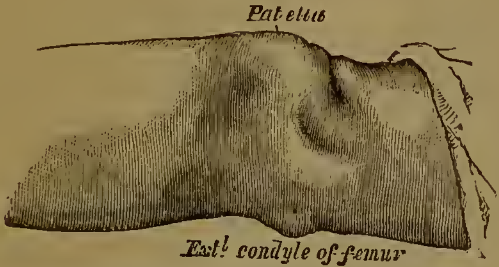
Varieties.

This accident can only occur from great violence, the ligaments that bind the bones together being very strong; yet it does occur, the tibia being displaced *backwards, forwards*, or *laterally*. Four examples occurred at Guy's in ten years. When *partial*, no complication, as a rule, exists, and the lateral is usually of this nature; when *complete* the soft part about the joint and the fibrous tissues within are often so injured as to render it a great question whether the joint, or even the limb, can be saved. The backward and forward dislocations are usually of this kind. When the popliteal artery or vein is injured or ruptured amputation of the limb may be called for, this necessity being rendered more than probable when the circulation through the vessels is not speedily restored after the reduction of the dislocation, or when a swollen condition of the limb remains. These dislocations are readily diagnosed by the peculiar deformity they display, and are easily reduced, by extension and the application of pressure, where pressure is needed. In the case from which Fig. 464 was taken, pulsation in the vessels was arrested, but it returned on the reduction of the dislocation, and recovery with complete movement of the joint was obtained. After the parts have been replaced in their normal position, splints should be adjusted and cold applied, for secondary inflammation is almost sure to follow. In rare cases the displacement is permanent and the limb is left useful. Thus in a man æt. 20, under my care, the left tibia and fibula were displaced partially inwards five years before I saw him from a fall in wrestling. The inner condyle of the femur rested on the outer articular facet of the tibia, and the head of the fibula seemed to rest between the condyles of the femur. The man had good though not complete movement of the joint, could walk well and carry loads.

Diagnosis.

Treatment.

Fig. 464.



Partial dislocation of the left tibia and fibula forwards, taken from a man, æt. 23.

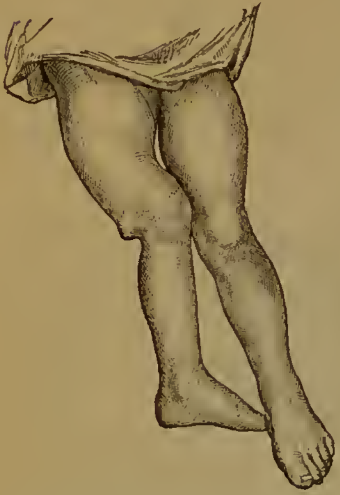
Epiphysial displacement.

A displacement of the lower epiphysis of the femur with the leg bones may be mistaken for dislocation of the knee; and in young subjects where this latter accident is supposed to have taken place the Surgeon should always consider the probability of the injury being of the former kind. In Fig. 464A this accident is well illustrated; it was taken from a boy æt. 10, who was under my care at Guy's some years ago. The epiphysis had been displaced inwards off the shaft of the femur and rotated inwards; and the lower end of the diaphysis of the femur was nearly through the soft parts on the outer side of the limb. The parts were restored to their normal position by manipulation and extension, and the limb fastened on a splint; a good recovery with perfect movement of the joint was the result. In some cases fracture coexists, and in exceptional examples, where the end of the diaphysis projects through the soft parts, its resection may be required to allow of its reduction.

Compound dislocation of knee.

Compound dislocations of the knee are generally so serious as to necessitate the removal of the joint. The attempt to save it should only be made in exceptional cases—amputation or excision may be selected.

FIG. 464A.



Separation and rotation inwards of the lower epiphysis of the femur, with the leg bones, from the shaft of the femur. Taken from a boy, æt. 10.

Dislocation of head of fibula.

Diagnosis.

Dislocation of the head of the fibula is occasionally met with. I have seen but three examples, one when dressing for the late Mr. Aston Key, and two since. It is generally caused by some violent adduction of the foot with abduction of the knee, the head of the fibula tearing through its ligamentous attachments and becoming displaced outwards. The accident can be readily recognised by the projection of the bone. It should be treated by the application of a pad and pressure over the part, sufficient to keep the bone in its place, the limb being flexed when necessary, to relax the biceps femoris. The pressure should be maintained for at least two months if good success is to be looked for; as a rule, the bone never quite resumes its former position, the head projecting more than usual. This deformity, however, does not appear to weaken the limb to any great extent.

Dislocation of the interarticular cartilages.

Symptoms.

Dislocation of the interarticular fibro-cartilages (semilunar) is a recognised accident. It is produced by some sudden twist of the knee with the foot everted, and generally in subjects who have relaxed joints, or such as have been the seat of some chronic synovitis. The inner cartilage seems more liable to displacement than the outer. The symptoms of the accident are well marked. A patient when walking, accidentally catches his foot against a stone, or in rising from a kneeling position is seized with a sudden, sharp, sickening pain in the knee; the joint becomes at once fixed in a semi-flexed position, and any attempt to move it only excites some pain. When the first agony has subsided, a painful spot is usually left, where the projecting cartilage may be felt or even seen, and, if the "internal derangement of the joint," as it was originally called, is left untreated, synovitis or effusion into the joint will soon show itself. When these symptoms follow such an accident as has been described, the cartilage has probably been torn from its attachment to the tibia and been doubled in or displaced.

Mr. J. F. Knott in an able paper, 'Dub. Journ. of Med. Sci.,' June, 1882, p. 479, has shown that in "the combined twisting and lateral movement conveyed to the knee at a moment when the ligaments are as lax as possible, the margin of the condyle of the femur is *jerked over* the edge of the internal semilunar fibro-cartilage. The immediate result is pressure of this structure, which is increased when the resulting pain brings about spasmodic contraction of the surrounding muscles.

Treatment thereof.

Treatment.—The best practice consists in the forced flexion of the joint, the slight rotation of the leg outwards, and sudden extension; pressure with the thumb upon the cartilage above the edge of the inner condyle of the tibia during the flexion and extension often being of use. When success attends this manœuvre, the joint moves smoothly and without pain, and the patient will at once be able to move the joint freely. At times, the reduction of the displaced cartilage is attended with a decided snap. After its reduction, the joint should be kept in a splint, and such means employed as the symptoms that follow indicate, for more or less inflammation often ensues, requiring ice, cold lotions, leeching, and rest. When active symptoms have subsided it is well to restrain the movements of the joint by means of a knee-cap or strapping, as a recurrence of the accident is liable to follow upon the least occasion. I have on several occasions thought that disease has been excited when this measure has been omitted, and I once saw anchylosis follow. Permanent lameness is by no means uncommon. When the Surgeon fails to reduce the displaced cartilage, the patient at times suddenly gains relief by its spontaneous reduction during some accidental movement. In other cases the cartilage resumes its normal position more slowly. In 1873, I saw a case of this kind where spontaneous reduction always occurred after its displacement. It was in a gentleman æt. 30, and the inner cartilage projected beyond the head of the tibia in a most marked manner. The patient should be kept in bed, and only allowed to move the limb, but not to stand upon it. When this result is not secured the joint should be strapped up to restrain movement.

Results.

Dislocations of the Ankle-joint.

Dislocation of the ankle.

Such an accident uncomplicated with rupture is rare—that is, dislocation of the foot *outwards* is generally associated with fracture of the fibula; and dislocation *inwards*, with fracture of the tibia; or both malleoli may be broken. Pure dislocations of the foot *forwards* or *backwards*, however, may occur. These dislocations are given in the order of their frequency, and are usually produced by some violent twist or bending of the foot when the patient is jumping, or by some violent impulse of the body, with the foot fixed.

Varieties.

Dislocation of foot outwards —Pott's fracture.

Causes.

Dislocation of the foot *outwards* is better known as *Pott's* fracture (Fig, 465), the fibula being usually broken two or three inches above the external malleolus. It is caused by a violent bending of the foot outwards with the foot everted, its outer edge being raised and the inner turned downwards on the ground. At times, the extremity of the inner malleolus is broken off and displaced outwards, with the foot and astragalus. Under all circumstances, the lower end of the tibia or inner malleolus forms a prominent projection inwards, leading or misleading Sir A. Cooper and his copyists to describe this accident as dislocation of the tibia inwards. At the seat of fracture of the fibula, a depression exists. When the force is continued beyond the point necessary to cause the displacement mentioned, the lower end of the tibia may be made to project through the soft parts, and thus give rise to a *compound dislocation*. In still more severe cases, the extremities of both tibia and fibula may be made to project, the foot being

Character.

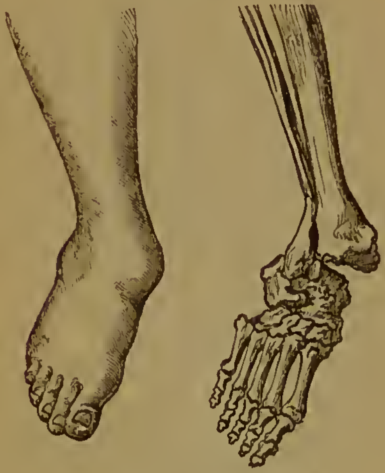
completely turned outwards. Exceptional cases occur in which the foot is turned out of its socket between the malleoli, without any accompanying fracture.

Dislocation of foot inwards.

Dislocation of the foot *inwards* (Fig. 466) is the counterpart of the last-described accident, and is caused by violence that turns the foot inwards, with its outer edge to the ground. It is usually associated with an oblique fracture of the inner malleolus and displacement. The force required to produce this dislocation is very great, the tibia being a far stronger bone than the fibula, the accident consequently is less common. The end of the fibula is often fractured and drawn outwards with the astragalus. At times the astragalus is also fractured. The accident is known by the inversion of the foot, the sole looking inwards, and by the projection of the external malleolus, this prominent symptom having led Sir A. Cooper to describe it as dislocation of the tibia outwards.

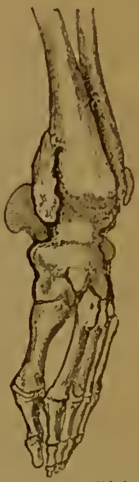
Character.

FIG. 465.



External appearances of foot in Pott's fracture. Taken from Pott's work.

FIG. 466.



A. P. Cooper. Dislocated foot inwards, with fracture of inner malleolus.

When the force is continued or more severe, either the fibula or the fractured or rather exposed ends of both tibia and fibula may be made to project through an external wound; and in still more severe cases I have seen this more than once, and in one a sound recovery ensued, with a movable joint. It was, however, in a boy, æt. 12. I simply reduced the dislocation after washing and dressing the wound, and fixed it in splints.

Dislocation of foot backwards.
Causes.
Character.

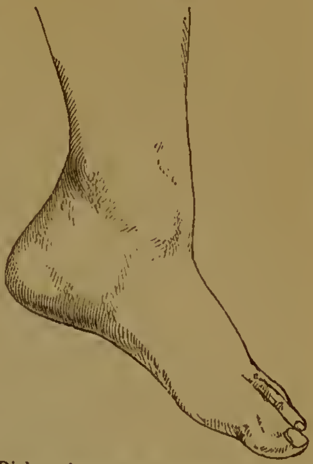
Dislocation of the foot *backwards* (Fig. 467). Sir A. Cooper called this dislocation of the tibia and fibula forwards. It is usually caused by the violent propulsion of the lower end of the leg bones forwards, when the foot is fixed, and is readily recognised by the shortening of the anterior surface of the foot and the proportionate elongation of the heel, with some pointing of the toes, as well as prominence of the lower end of the tibia. At times, the fibula is fractured and the point of bone carried backwards with the astragalus.

This accident is rare, it being more common to meet with fracture of both malleoli, and displacement of the foot and broken fragments backwards.

In 1862, I was called to treat a very marked case of this kind in a man, æt. 32. The astragalus with the foot seemed to have been shot completely out of its socket, and the extremities of the tibia and fibula projected so far forward as almost to rupture the soft parts covering them. The accident was caused by wrestling. The dislocation was reduced by flexing the leg on the thigh and by manipulation; but no means could be found to maintain the bones in position till the tendo Achillis was divided and the leg placed on its side and fixed on an outside splint. Mr. Cock ('Guy's Rep.,' 1855) has recorded a case of the same accident in a boy, æt. 16, where the same difficulty was experienced. He divided the tendo Achillis and bound the foot in splints, and a good result, as in my case, was obtained.

May require division of tendo Achillis.

FIG. 467.



Dislocation of the foot backwards. Cast 165, Guy's Mus.

Dislocation of the foot forwards is probably more rare than the last, and is generally only partial. It has been described as dislocation of the tibia backwards, and is known by precisely the opposite symptoms to those last described. The heel is shortened and the foot lengthened, the upper surface of the astragalus being capable of recognition by the fingers. Poland records such a case ('Guy's Rep.,' 1855), in which the whole foot was much elongated and the posterior part of the astragalus was caught in the anterior part of the tibia and fibula and wedged in tightly. Reduction was only effected after the division of the tendo Achillis.

Dislocation of foot forwards.

TREATMENT.—The lateral displacements of the foot are not difficult of reduction by extension and well-directed manipulative force. The flexion of the knee facilitates this operation by relaxing the muscles of the calf.

Treatment of dislocation of the ankle.

To keep the bones in position, a Macintyre or flat posterior splint extending up to the popliteal space, with foot-piece and two side splints all well padded, are sufficient, as a rule; the Surgeon using his judgment as to the amount of pressure and padding that may be demanded. In some cases where it is a very difficult matter to keep the parts quiet from the action of the gastrocnemii muscles, the tendo Achillis should be divided, the foot, after this simple operation, being perfectly passive, and entirely in the hands of the Surgeon to place and to keep in any required position.

Mode of keeping bones in position.

The limb should subsequently be slung in a proper swing, Salter's being the best. In hospital practice, two or more pieces of bandage slinging the splints to the cradle answer well. In the displacement of the foot forward or backward the same kind of treatment is applicable; but in these accidents, it is expedient, as a rule, to divide the tendo Achillis at once. This should be done at any rate when the slightest

Splints, &c.

disposition to displacement is found to exist, the treatment of the case being by this operation rendered more simple and certain.

The splints should be retained for at least six weeks, and afterwards passive movement should be allowed. The patient should not bear any weight on the limb for another month.

Treatment of compound dislocation of ankle.

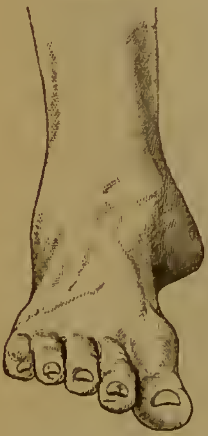
When resection necessary.

When amputation to be preferred.

After-treatment of compound dislocation of ankle.

The treatment of *compound dislocation of the ankle-joint* cannot be reduced to any definite rules. Each case must be treated on its own merits. In young and healthy subjects, more may be attempted in the way of saving the joint than in the old or cachectic. When a small wound exists, operative interference is only exceptionally needed; but when a large one with projection of the bones, it is a question whether the better practice lies in the reduction of the dislocation after cleansing the projecting bones, or in their resection. When the bones cannot be reduced by ordinary force, their resection becomes a necessity. When the bones are much crushed their resection should always be undertaken; indeed, it is a general feeling in my own mind, that in compound dislocations, as in compound fractures with a large wound it is wiser to resect the ends of the projecting bones than to reduce them. Amputation of the foot should only be performed when the soft parts and bones are much injured, and the age of the patient or his want of power forbids the hope that a recovery with a useful limb can be secured. Before any attempt at reduction is made the parts should be thoroughly cleansed. After the reduction of the dislocation, whether simple or compound, the application of ice or cold is of great value, or the treatment by irrigation. In the suppurative stage the latter practice is probably the better of the two. When the wound is only of a limited nature it may be sealed at once, either by lint soaked in blood, or, what is better, by the compound tincture of benzoin. The joint in such cases may be washed out with a weak solution of carbolic acid (1 part in 40) or iodine water before the wound is sealed. Opposite the wound an interrupted splint should be employed.

Fig. 468.



Dislocation of ankle. Astragalus between tibia and fibula. Cast 160, Guy's Mus.

Secondary amputation may be called for in these cases, on account of gangrene, or a failure in nature's efforts to effect repair, &c.

Dislocation of astragalus between tibia and fibula.

Dislocation of the tibia and fibula at their lower articulation, with a forcing of the astragalus upwards between the two bones, is an accident which must be recognised (Fig. 468), and is usually produced by a jump from a height on the foot or feet. I saw a good example of it in 1869, in both feet of a man, æt. 55, who fell from a scaffold. The malleoli were widely separated and projected, the depth of the foot from the extremities of the malleoli was lessened, and the movements of the foot almost gone. No fracture could be made out. It was impossible to move the bones from the position in which they were wedged, although all means were used. Yet a good recovery took place, though with stiff joints. I have seen a like case since in a man who jumped from a high window, but in it some fracture of the astragalus complicated the injury; the man did well.

Dislocations at the tarsal joints are met with in practice, although but rarely. They are difficult to diagnose, and still more to classify, since they are so variously described by different writers. The first to be noticed is

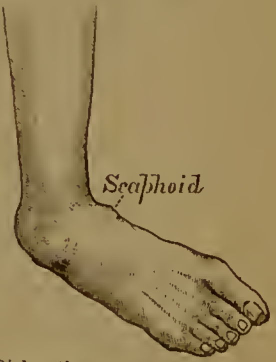
Malgaigne's sub-astragaloid.

Subastragaloid dislocation of the foot, in which the astragalus maintains its normal position with the tibia and fibula, but loses it with respect to the rest of the foot. Mr. Arnott communicated to the 'London Med. Gazette,' vol. xv, 1837, p. 588, the report of a case, in which he and Mr. A. Shaw recognised the nature of the accident, but the possibility of such an accident was doubted till Mr. Pollock, in 1859 ('Med.-Chir. Trans.,' vol. xlii), published two cases—one occurred in Mr. Keate's practice in 1823—and in it the os calcis and scaphoid, with the other foot bones, were displaced *outwards* off the astragalus. In the other, which occurred in his own practice, the same bones were dislocated *inwards*. A dissection of this case is given. In Keate's case the foot was everted, and the head of the astragalus projected on the inner side of the instep. In Pollock's the foot was inverted, so that the sole turned inwards, as in varus; the external malleolus was very prominent, and the astragalus projected on the other side. In some instances the surfaces of the foot are maintained in their right line. In Mr. Pollock's case reduction was found to be impossible till the tendo Achillis had been divided, when it was readily accomplished. In an able paper he advocates this practice whenever difficulty of reduction of the inward or outward dislocation, simple or compound, is experienced, and shows that the division of the posterior tibial tendon is occasionally called for in the outward. Mr. Turner, of Manchester, had previously advocated the same practice ('Trans. Prov. Med. and Surg. Assoc.,' vol. ix).

Division of tendo Achillis may be required.

In 1882 a man, æt. 36, came under my care with displacement of the foot *outwards* off the astragalus, and slight eversion of the foot. The head of the astragalus projected through a large wound in the soft parts above and within the tubercle of the scaphoid and above the tendon of the posterior tibial muscle. Reduction was found impossible until a portion of the head of the bone was removed, when the parts were replaced and the case went on to a satisfactory conclusion, with movement in the ankle-joint.

Fig. 469.



Dislocation of foot inwards off the astragalus. After W. MacCormac.

An admirable paper on this subject has been published by Sir W. MacCormac ('St. Thos. Hosp. Rep.,' 1872). The woodcut produced (Fig. 469) is taken from it, from which it will be seen that "the foot was violently inverted and adducted, its position being like that of talipes varus. The sole of the foot looked inwards, and was nearly vertical, the outer edge of the foot, with the patient erect, would rest partially upon the ground. The great toe pointed towards the arch of the opposite foot. The inner border of the foot was somewhat shortened and more concave, while the outer was more convex than natural, and appeared as if lengthened. The outer malleolus was very prominent, while the inner could not be perceived, so deeply was it buried. Neither malleolus was fractured, and this would seem to be almost characteristic of this form of injury.

"The rounded head of the astragalus completely dislodged from the scaphoid, was resting subcutaneously over the calcaneo cuboid articulation. The prominence caused by the head was somewhat masked by swelling of the soft part just below it. The skin covering the head was so tensely stretched that it seemed ready to burst, and a circular slough subsequently formed at the spot. The outline of the head could, however, be easily traced, and the finger, on being passed upwards beneath the external malleolus, readily felt the cartilaginous surface of the large posterior articulating facet of the astragalus. Most of it was quite subcutaneous, and its external margin rendered the skin very tense. The interosseous ligament had been ruptured. The tuberosity of the scaphoid stood out prominently, and a depression could be felt behind it. The motions of the foot were very limited." Macdonnell, of Dublin ('Dub. Journ.,' 1839), published a case in which the same bones were displaced *backwards*, where the heel projected, and a marked prominence existed on the dorsum of the foot, with an abrupt descent in front on the tarsus.

Case of dislocation backwards.

In 1862 I had to amputate the foot of a man, æt. 24, for a compound dislocation of the foot *backwards*, off the astragalus, with fracture of the calcis. When seen the foot was turned inwards and much foreshortened, and there was a bony eminence in front of the external malleolus, which turned out to be the displaced anterior third of the os calcis. The accident was caused by the man's foot becoming wedged between the spring and step of a locomotive, and his body falling outwards. On dissection the astragalus was found in its normal position, between the malleoli, but with its head resting on the scaphoid bone, between the tendon of the tibialis anticus on its inner side and of the long common extensor on the outer. On the outer side of the foot the displaced portion of the os calcis was resting on the dorsal surface of the cuboid bone; the rest of the calcis was completely dislocated backwards; its upper and posterior articular facet projecting beyond the astragalus. The extreme end of the external malleolus was broken off. The peronei tendons maintained their position behind the external malleolus, but were much stretched.

Dislocation forwards.

M. Parise ('Annales de la Chirurg.,' 1845) gives an instance which is apparently unique, of dislocation *forwards*, in which marked elongation of the foot existed, and the projection of the heel was effaced.

Examples of sub-astragaloid dislocation.

All these dislocations are rare. The first example of dislocation inwards that I have seen was recorded by Mr. Cock, in 'Guy's Hosp. Rep.,' for 1855, with a drawing; but in my work on the 'Joints,' 1859, I published (Case 85) an example of dislocation of the foot outwards, with a description of the dissected extremity, which had occurred in the practice of Mr. Aston Key, in 1845. The foot was amputated, reduction being impossible. The ankle-joint was perfect. The os calcis with the foot was displaced outwards. The tendon of the tibialis posticus was found in front of the tibia holding down the astragalus. The posterior tibial nerve was violently stretched over the astragalus. The limb was removed for tetanus, and the symptoms immediately disappeared after the amputation. A large number of these cases are compound; and in some they are complicated with

Dislocation often compound.

fracture of the fibula. Broca ('Mém. de la Société de Chirurg.,' tome iii), out of 13 examples of dislocation outwards, gives 9 as compound.

This dislocation may be diagnosed from displacement at the ankle-joint and dislocation of the astragalus itself by the fact that extension and flexion are present; from fractures about the ankle, by the absence of crepitus, together with the positive signs of the injuries themselves.

Treatment of dislocation.

Treatment.—Reduction should only be attempted with the patient anæsthetised, and under such an influence, by extension and manipulation success may be looked for. When difficulties are experienced Turner and Pollock's suggestion of dividing the tendo Achillis, and even the posterior tibial tendon, or any other tendon, when it is clearly interfering with the replacement of the bones, should be followed. When these means fail and the stretched skin gives way, the case must be treated as one of a compound nature, and the astragalus partially is excised, the foot being subsequently well confined in splints and ice applied. Occasionally amputation may be demanded, or Syme or Pirogoff's more partial operation.

Dislocation of the astragalus alone.

Dislocations of the astragalus alone are said to be more common than the former accidents. I have seen several such, but I am disposed to think I have mistaken some cases of subastragaloid dislocation for dislocation of the astragalus. Pollock believes the pure dislocation of the astragalus to be very rare.

Varieties.

The bone may be shot out of its socket *forwards, backwards*, and even *laterally*, and in rarer examples, *rotated* on its axis.

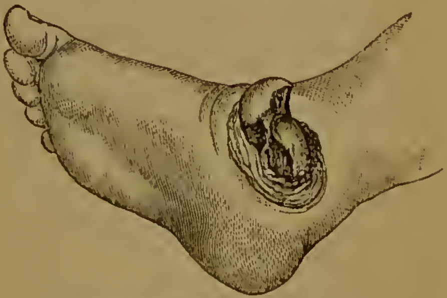
Dislocation forwards.

In the dislocation *forwards*, the head of the bone projects from between the malleoli; in some being shot inwards so as to form a marked eminence beneath the internal malleolus, in others outwards. In such an accident, the heel remains in its normal position, and all movement of the ankle-joint is lost.

Dislocation backwards.

The dislocation *backwards*, of which Phillips ('Med. Gaz.,' 1834) and Turner have cited examples, is indicated by the remarkable projection which suddenly appears above the heel, pressing out the tendo Achillis, by the shortening of the foot, and the prominence of the tibia in front.

Fig. 470.



Compound dislocation of the astragalus.

Lateral dislocation of astragalus.

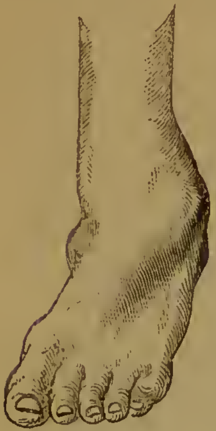
Dislocation of the *astragalus laterally* to be complete must be compound (Fig. 470), and when incomplete at first, will probably become complete at a later period through sloughing of the soft parts. It is generally but not always, complicated with fracture of one or other of the malleoli. Boyer has recorded a case of dislocation of the astragalus *inwards* in which no such complication existed, and in 'Guy's Reports,' for 1861, p. 293, I recorded an example of dislocation of the bone *outwards* in a man, æt. 51, in which both malleoli were entire; the astragalus had been fractured and turned completely out of its bed, and was found hanging to the wound below

Dislocation of astragalus inwards.

Dislocation of astragalus outwards.

the external malleolus. I removed the broken fragments at once, and brought the foot into a good position; a complete recovery with a stiff joint ensued. Sixteen years after the accident, the man walked about without the aid of a stick, and with no other inconvenience than that occasioned by a stiff joint, which he maintained is a very slight matter. Fig. 471 illustrates a case of dislocation of the bone outwards, complicated with fracture of the fibula.

Fig. 471.



Dislocation of the astragalus outwards, and fracture of the fibula. Cast 161.

Rotation of the bone often coexists. Mr. Barwell has written ('Med. Chir. Trans.,' vol. lxvi, 1883) an interesting paper upon this subject and gives a case in which he resected the astragalus with a good result. He tells us, "The bone may be turned either horizontally so that its long axis looks across the joint and at right angles to its normal position, and this he would call version; or it may turn over sideway upon its antero-posterior axis, which might be termed torsion." That Mr. Barwell is right there can be no doubt. In 1878 I removed from the inner side of the ankle-joint of a man the necrosed upper half of the astragalus that had its articular facet looking inwards. He had received an injury to his ankle six months previously, which was regarded by the Surgeons who treated him as one of fracture of the leg.

Treatment of dislocation of astragalus.

Treatment.—In simple dislocation of the astragalus when the bone can be replaced by manipulation, nothing more is needed; but such a result cannot always be secured. When it cannot, even under chloroform, the tendo Achillis should be divided. In 1862 I was called to see a man, æt. 28, who had fallen on his feet from a height of four yards, whose right astragalus was shot forward completely out of its socket, and nearly burst through the skin. In this case chloroform had been given, and every kind of manipulation and extension employed by competent men to reduce the bone, without effect. I divided the tendo Achillis, extended the foot fully, and applied gentle pressure to the projecting astragalus, when the bone slipped back readily into its place. Some crepitus was felt, however, and I believe a horizontal fracture of the astragalus co-existed, the upper surface and head of the bone having been displaced forwards. The foot was fixed in side splints, and a good recovery ensued with a movable joint.

When astragalus cannot be reduced.

When the displaced bone cannot be restored to its normal position directly after the accident, it is now fairly a settled question that it should not be removed till after the tissues have sloughed. Sir A. Cooper strongly advocated this practice, and Broca has since supported him, showing by an analysis of cases, that in 36 examples of irreducible simple luxation in which the bone was removed at once, one fourth were fatal; while in 43 in which the bone was left alone, only 2 deaths took place; in 2 amputation was performed; in 16 the bone was removed after sloughing, and all recovered; in 23 no operation was called for, recovery taking place with a useful limb.

In compound dislocation of astragalus.

In all compound dislocations of the astragalus, the removal of the bone should always be effected.

Dislocation of the other tarsal bones.

Dislocations of the other tarsal bones have been recorded. Malgaigne relates two cases of *dislocation of the calcis* outwards, the bone forming a projection beneath the external malleolus and beyond the cuboid articulation. In 1865 I saw a case of Mr. Birkett's at Guy's, in which the left *scaphoid bone* was displaced inwards and formed a very marked projection. It was readily reduced by pressure under chloroform, at a moment when the distal end of the foot was drawn outwards. I have the notes also of a case of dislocation of the *internal cuneiform* bone upwards with the metatarsal bone of the great toe, in a man æt. 24; of a second, in a man æt. 30, in which the same bones were displaced inwards, the accident having been produced by a weight falling on the outer ankle when the foot was resting on the great toe. In both, reduction was readily effected with a good result.

Dislocation of the internal cuneiform.

Holthouse informs us that the internal cuneiform bone may be separated from all its articulations, and thrown upwards and inwards. The three cuneiform bones are also sometimes luxated together upwards, and without much difficulty may be reduced by pressure.

Dislocation of the scaphoid and cuboid.

The *scaphoid* and *cuboid* bones may also be displaced. Malgaigne has described this accident as a middle tarsal dislocation; Liston has described it in his 'Practical Surgery;' and Sir A. Cooper in his work 'On Dislocations.'

Dislocation of the metatarsal bones.

Dislocations of the *metatarsal bones* may likewise occur. In 1854, I saw a case recorded by Mr. Cock ('Guy's Rep.,' 1855), in which the entire metatarsus appeared to have been separated from its attachment to the cuneiform and cuboid bones and thrown on the dorsal surface of the instep, where their bases could be seen and felt. The internal cuneiform and navicular bones appeared to have been likewise injured. The injury was the result of a crush from the wheel of a railway waggon. All Mr. Cock's efforts at reduction failed, but a good foot was secured, and the man subsequently returned to his work as a labourer on the railway.

In March, 1884, a man, æt. 36, came under my care with displacement of the three inner metatarsal bones upwards and outwards, caused by the passage over the foot of the wheel of a cart loaded with a ton and a half of bricks. Under chloroform and by manipulation the bones were readily reduced and a good result ensued. I suspected at the time there was a fracture of the third bone.

Dr. Hetzig ('Syden. Soc. Bien. Rep.,' 1865-6), who gives us an analysis of 29 cases of these tarso-metatarsal dislocations, states, that 13 were of single bones, 16 of the entire metatarsus, some of these being lateral and others vertical, as in Cock's case. In the former, greater inconvenience follows from a failure in reduction.

Dislocations of the phalanges.

Dislocations of the phalanges are less common than those of the finger, and chiefly occur upwards from direct violence to the ends of the toes, and, as a rule, are compound. The great toe is the one usually injured, and, as in the thumb, considerable difficulty is at times met with in its reduction, the ligaments and many tendons around the joint affording an explanation of this fact. Such a case should be treated in the same way as dislocation of the thumb. Reduction must always be effected, when possible, by extension and well-directed pressure; forced flexion or extension sometimes facilitates the process.

Congenital Malformations (dislocation) of Joints.

It has been the habit of authors to describe cases included under the above heading as examples of *dislocation ;* but it is clearly more correct to regard them as malformations, for as met with in the shoulder, clavicle, wrist, and lower jaw, they are always associated with a want of development in the bones, and paralysis of the muscles of the part. When seen in the hip, there is likewise good reason to believe that congenital deficiencies are also present, as the anatomical facts which bear upon the point support this view; one such is given by Cruveilhier in the second plate of the second volume of his 'Pathological Anatomy,' where an engraving of a skeleton in which this congenital displacement existed, shows it to be the result of a want of depth, from incomplete formation, of the acetabulum; and another is furnished by a valuable preparation in the Middlesex Hospital Museum (Prep. 12, series 3), in which there is practically no acetabulum, but a strong capsule and a well-developed head of the femur without a ligamentum teres.

In hip joint.

Dr. A. G. Drachman ('London Med. Rec.,' May 18th, 1881) reports a case of a child born of a mother with this deformity, who died on the seventh day, in which the left acetabulum was considerably shallower than normal, and the ring of cartilage was turned outwards at the superior, posterior, and outer part, forming an inclined plane over which the head of the femur glided upwards and backwards on the ilium. The whole of the left side of the pelvis was atrophied, and the atrophy extended to the head of the femur, which, as well as the head of the bone on the right side, was small.

Mr. Barker pointed out in a discussion at the Roy. Med. and Chir. Soc., November 17th, 1883, that in the Musée Dupuytren the specimens showed either absence of the ligamentum teres or its lengthening to a mere cord 2½ inches long.

Fig. 471.

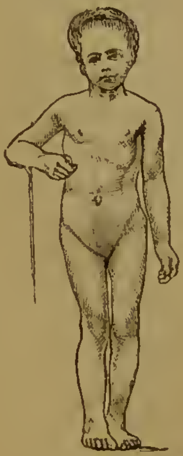
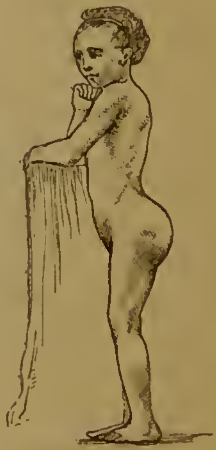


Fig. 471a.



Case of congenital displacement of both femora.

Anterior view. Side view.

Congenital displacement of hip.

This *congenital displacement of the hip* is by no means an uncommon affection, and is often mistaken for hip or spinal disease, more particularly when one joint alone is implicated. It affects both joints in one third of all cases, and occurs in female rather than male children in the proportion of 5 to 1. It is found also in those who are in all other respects well in health and perfect in form, and although it has been boldly *asserted* that "it is beyond doubt that this dislocation is produced at birth through downward force applied to the thigh in endeavouring to hasten the birth in breech presentations," no evidence has been published to support the view. On reviewing my own experience, I must add that it does not in any way encourage such an opinion, for whilst in no case have I been able to learn that a breech birth took place, I heard in the majority that a natural birth occurred.

Symptoms.

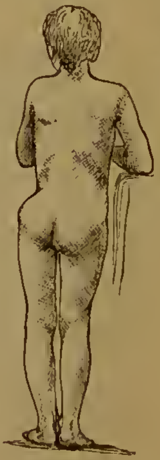
The symptoms of the displacement are very marked, and in its double form are well shown in the foregoing drawings taken from life (Figs. 471, 471A), the most conspicuous being lordosis, a peculiar breadth of hips, rounding of the buttock, rotation of the whole extremity and foot inwards, and slight flexion of the thigh—in fact, the symptoms of dorsal dislocation of the hips.

Lordosis: how produced.

The lordosis is produced in these cases in the same way as it is in the accidental dorsal dislocation, or the acquired displacement of the head of the femur in hip disease, and can be effaced by elevation of the limb, with the patient in the horizontal position as in those cases (Figs. 539, 541).

The movements of the joint are good, at times perfect, and give rise to no pain. The head of the femur also rotates smoothly on the ilium.

FIG. 471B.



Congenital displacement of head of left femur. Posterior view.

When one joint is affected.

When one joint only is affected (Fig. 471B), there will be shortening of the limb for about an inch, and on comparing the affected with the sound side it will be at once seen that this shortening is in the thigh, and that the trochanter is drawn up to the level of the anterior superior spine of the ilium.

Peculiar walk.

The walk of a patient with a double displacement is very curious; it is a kind of "roll," not unlike that of a woman going upstairs who has some loosening of her sacro-iliac joints or very broad hips. While a patient with a single affected joint limps and has an awkward gait, which has often led parents and others to suspect hip or spinal disease, more particularly when by over-use of the malformed joint, pains are excited. Occasionally the muscles of the affected limb or limbs are weak, but this is met with in only exceptional cases.

Treatment.

TREATMENT.—Nothing can be recommended with the view of cure, for art cannot supply a natural deficiency or make up for a defect of structure in the bones of the joint. Still, surgery can do much towards the prevention of additional trouble by exercising the muscles of the limb and body without fatiguing them; forbidding excessive standing or walking during the years of growth, and attending to the general health.

Mechanical appliances are to be condemned as useless, if not worse. They have been employed on a wrong principle, or rather on a want of due appreciation of the conditions of parts, and therefore with only a vague hope that they may do good. These observations apply as much to the use of an extension apparatus as to operative interference, although with more force to the latter.

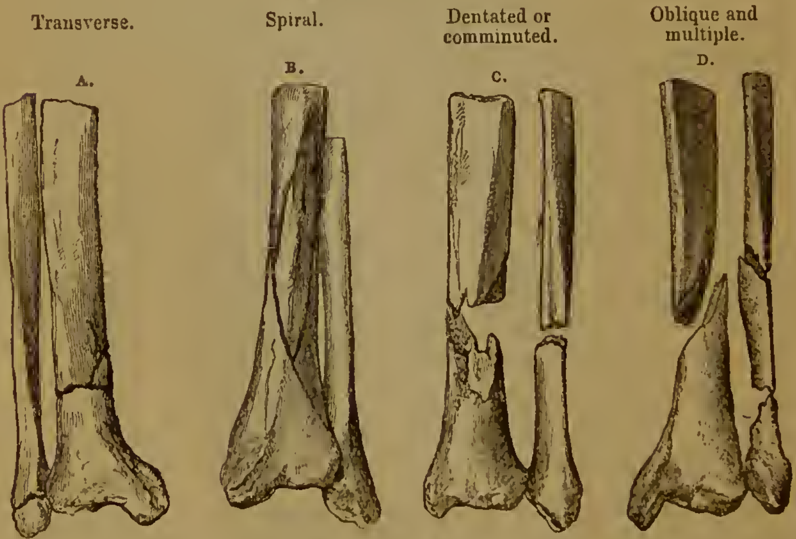
CHAPTER XXXI.

ON FRACTURES.

Definition. When a bone is broken, it is said to be fractured; when the skin and soft parts covering in the broken bone are whole, the fracture is *simple* or subcutaneous; when a wound exists *communicating with the broken bone,* whether the wound be caused directly by the same force that produced the fracture or indirectly by the bone perforating the skin, the fracture is *compound.* **Varieties of fractures.** A simple or compound fracture is said to be "*complete*" when the solution of continuity is complete; "*incomplete,*" when the bone is only "*cracked,*" "*fissured,*" or "*bent,*" as in "*greenstick*" fracture, where the bone is splintered on its convex surface and not on its concave; "*splintered,*" when only a portion of the bone is cut off either by a sabre wound, in machinery, or by some local injury chipping off the edge of a bone; "*fissured,*" when the line of fracture extends partially or wholly through the bone and no separation of the fragments exist; "*impacted,*" when one end of the broken bone is driven into and fixed in the other. A bone may also be *perforated* by a gunshot or punctured wound.

Fig. 472.

Complete Fractures.



Prep. Guy's Hosp. Mus.

A *complete fracture* may be transverse, oblique, longitudinal, spiral, dentate, or comminuted; multiple of the same bones, or of contiguous bones, of separate or distinct bones (*vide* Fig. 472). All fractures may likewise be complicated with other injuries, those into joints being the most important. Fractures and separations of epiphyses are also intimately connected; but fractures may occur at any age, while separation of the epiphyses is rarely found in subjects above twenty-one.

Time of life.

Intra-uterine.

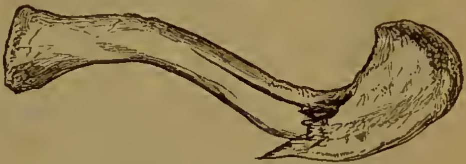
A fracture may be met with at every period of life; indeed, it may occur *in utero* from some external violence, and, when the accident has taken place some time antecedent to birth repair may have gone on to completion although in most cases with deformity—the *vis medicatrix naturæ* being, as Billroth well observes, a better physician than surgeon. I have seen this in an infant who was born with a humerus bent at right angles, evidently from a repaired intra-uterine fracture. During the delivery of a fœtus, by turning, the shaft of a femur, tibia, or fibula may be displaced from one or both of its epiphyses. By hyperabduction of the femur the upper epiphysis of the bone is likely to suffer, and by traction on the foot those of the lower end of the tibia and fibula. (Dr. Alexander Simpson, 'Edinb. Med. Journal,' June, 1880. M. Delore, 'Dict. Encyclopéd. des Sciences Médicales,' iv. 201; 1879). The fractures of infancy are comparatively rare, and are commonly incomplete, or "green-stick." Fig. 473 illustrates this in the clavicle, and Fig. 474 in the parietal bone. The latter was taken from a child, æt. eight months, who was thrown out of a perambulator on the pavement. No symptoms of brain disturbance followed the accident at any time. The drawing was taken on the second day following the accident. The case occurred in the practice of Mr. Harris, of South Hackney. In some such cases as these, the depression in the bone may, as time passes, be gradually pressed out, but in others it is permanent.

In infancy.

Incomplete fracture.

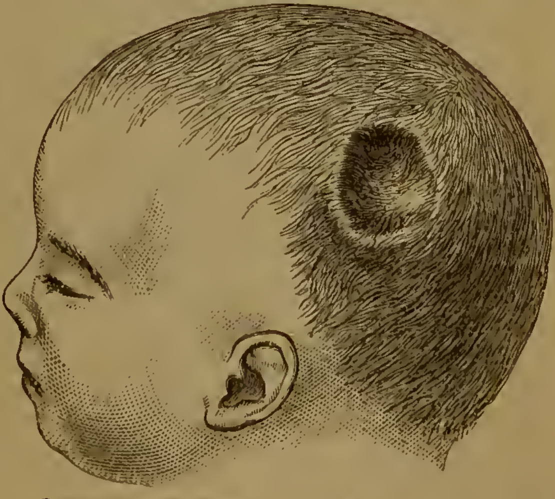
Case of.

Fig. 473.



Incomplete fracture of the clavicle. From 'Holmes's System.'

Fig. 474.

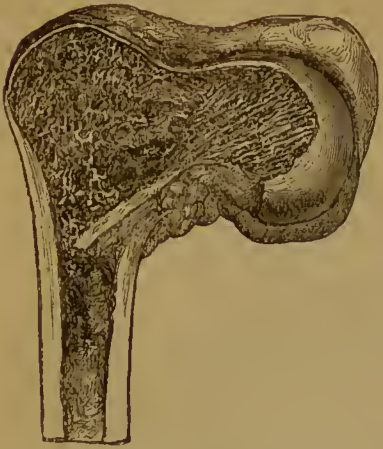


Incomplete fracture of the parietal bone of infant.

Impacted.

Fractures in the adult are mostly complete, though an incomplete fracture may occur. *Impacted fractures* (Fig. 475) are chiefly found in the aged, the bones at this period of life being more brittle than they are in younger subjects. They are commonly met with in the neck of the femur and the lower end of the radius, although they occur in the neck of the humerus, and other parts. Thus in Fig. 512 is illustrated an impacted fracture of the shaft of the femur. Many *comminuted* fractures are doubtless due to impaction of one fragment of bone into the other, and to the subsequent splitting of the latter.

Fig. 475.



Impacted fracture of the neck of the thigh-bone. Taken from a man, æt. 64, who recovered from the accident.

Men are more exposed to fractures than women on account of their more constant liability to injury, and those bones suffer the most that are the most exposed to external violence, hence the frequency of fracture of the lower extremities.

Bones in some subjects are very brittle, and break from slight causes; *fragilitas ossium* is said then to exist. This condition may be hereditary. These bones, however, as a rule unite rapidly. In August, 1883, I saw a case of fracture of the neck of the thigh-bone which took place when a woman, æt. 83, was slowly walking from her bed to a chair.

Diseased bones predisposed to fracture.

Diseased bones are always predisposed to fracture from slight causes, more particularly the rickety and cancerous, and likewise bones that are weakened by the presence of tumours or some syphilitic or other inflammatory affection.

Fracture from muscular action.

In diseased or brittle bones muscular action may be enough to cause fracture. Thus, I have known a thigh to be fractured in turning in bed, in an epileptic attack, and in swinging it over the side of a cart; the humerus, in the act of embracing a wife; and in a man, æt. 26, from throwing a stone; the clavicle, from lifting a heavy weight; the ribs, in coughing; the radius, from wringing clothes; and every Surgeon knows how frequently the patella and, more rarely, the olecranon are broken from muscular spasm. Mr. Parker records ('New York Journ. of Med.,' July, 1852,) a case in which a dentist, æt. 38, broke his humerus while drawing a tooth. Mr. J. Anningson, of Burnley, has recorded a case of a woman, æt. 42, in which the upper three fourths of the tuberosity of the calcis was fractured, and displaced upwards by muscular action ('Brit. Med. Journ.,' Jan. 26th, 1878). Mr. Ball likewise records a similar case ('Dublin Path. Society'), Nov., 1880.

Patients with disease of the nerve centres are very prone to suffer from fracture. Davey, in 1842, noted the fact that lunatics often so suffered, and the frequency of broken ribs from slight causes in lunatic subjects can be explained by this liability. Weir Mitchell, in 1873 ('American Journ. of Med. Science,' July), first called attention to the connection between fracture and locomotor ataxy and suggested impairment of nutrition as the cause. Later on Charcot emphasized the fact, and at the same time noticed how rapidly repair took place in the broken bones.

Fractures in insane people.

Ormerod's observations.

"From a review of the observations made on the bones of two insane patients," writes Dr. Omerod ('St. Bart. Hosp. Rep.,' 1870), "it may fairly be inferred that the brittleness of the ribs depended on a morbid condition of the bones, and that this condition was general, affecting different parts of the osseous system coincidentally, though more marked in the ribs than in some other more compact bones. The process was essentially one of absorption of the internal structure of the bone, the osseous tissue being replaced by an excessive deposit of the fatty matters normally existing in its interior. Thus the usually invisible membrane lining the Haversian canals, and forming the coats of the vessels lying there, was thickened into a membrane of cognisable structure and dimensions. The space for this thickening was obtained by removal of the innermost concentric laminæ; and from this point a change was propagated which resulted in or tended to the removal of each entire Haversian system. In the whole bone there was a loosening of the mutual connection of the laminæ and an obscure disintegration of the osseous structure itself and a general infiltration of oily matter into the substance which had intruded itself within the Haversian canals, and into whatever part of the compact structure of a bone could find room for it."

In confirmation of these views I may mention, that I attended, with the late Dr. Black of Canonbury, a middle-aged lady, the subject of dementia and epilepsy, who in nine or ten fits, none of them having been violent, broke a bone, and on several occasions two. The fractures took place when the patient was in bed by mere muscular action, and repaired well; indeed, as well as if the subject of them had been quite healthy.

Cause.

The immediate cause of fracture is usually some *direct* violence applied to the part, or it may be *indirect*, the bone, under some bending force, giving way at its weakest point; "in the line of *extension*, not that of *compression*."—*Teevan.*

Indirect fractures are, as a rule, of the simplest kind, unless complicated with joint dislocation; when compound the soft parts are mostly injured by the protrusion of the fractured bone.

Fractures the result of *direct violence* are always the most severe, the same violence that breaks the bone injuring the soft parts over it, and often fissuring and comminuting it.

The mode of production of a fracture is, consequently, a point of great practical importance, both for diagnosis, prognosis, and treatment.

Diagnosis.

When easy.

SYMPTOMS.—The diagnosis of a fracture is usually easy, though in exceptional cases it is difficult, if not impossible. It is easy when, after a blow or fall, attended by the sensation of something giving way, *deformity* is found, with *inability to move the limb*; and on manipulation, *abnormal mobility* of the injured limb exists, with *crepitus* from the rubbing of the broken fragments together; when *pain* attends any attempt at movement, and *swelling* rapidly follows the accident; and when *shortening* exists, which is remedied by extension.

When difficult.

The diagnosis is difficult when, as in *impacted fractures*, abnormal mobility and crepitus are absent, and only slight but fixed deformity exists; when local pain and shortening are the only symptoms, and when the nature of the accident is the only guide. When a transverse fracture of such a bone as the tibia exists without displacement, and with no fracture of the fibula. When the fracture is into or in the neighbourhood of a joint, and there is much swelling of the injured part; and when a fracture and dislocation co-exist.

It is always difficult and at times impossible to make out a simple fissure of a bone, cranial or otherwise; and the same may be said of a fracture of the pelvis or thorax; such injuries as these can be made out only by the natural symptoms of fracture, as they are called, and by such as are referred to the contents of the cranial, thoracic, or pelvic cavities.

When a bone is broken near a joint, and effusion into it follows the injury, the Surgeon should suspect the presence of a fissure of the bone into the articulation; and when a V-shaped fracture of the lower third of the tibia is present the V occupying the *internal* or *subcutaneous surface* of the bone, and *not* the crest (*vide* Fig. 527), this complication is to be looked for.

It is sometimes difficult to diagnose a fracture from a separated epiphysis.

Deformity dependent on plane of fracture.

When a fracture is *transverse* (Fig. 472, A) there may be no or only some slight lateral displacement; when *oblique* (Fig. 472, D) there will probably be some shortening of the limb from the drawing up of the lower portion of the limb, or *riding*, as it is called, of one end over the other. At times there will be rotation of the limb, and in comminuted fractures separation of the ends of the bone (Fig. 472, C). These points will be greatly determined by the character of the fracture, the bone that is involved, and the amount of muscular action that influences the fracture.

In parallel and conjoined bones of which only one is broken, the deformity that exists is likely to be less marked than where a single bone is broken; for, under these circumstances, the non-fractured bone tends to neutralise the action of the muscles through which deformity or contraction usually takes place. Muscular action is undoubtedly the main cause of deformity, tonic action of the muscles existing under all circumstances, and spasmodic action when the muscles are irritated by fragments and attempts at reduction.

Muscular action the cause of deformity.

Muscular spasm being the main cause of deformity and shortening of the limb after fracture, it becomes an important point to recollect in treatment that the peculiar deformity associated with any special form of fracture can be obviated by neutralising the action of the muscles that produce it. Thus, in fractures of the humerus *above* the insertion of the deltoid, the action of the latter muscle will be to draw the lower fragment up and outwards, while the pectoral muscle has a direct influence in drawing in the upper fragment. In fractures of the humerus *below* the insertion of the deltoid, the tendency of this muscle will be to draw the upper fragment outward, and the brachialis anticus has an equally powerful tendency to draw the lower half forward. In fractures of the thigh-bone below the minor trochanter, the psoas and iliacus muscles naturally draw the upper fragment forwards, and rotate it outward, and, in fracture of the condyles, the gastrocnemii have a powerful tendency to draw the lower end backward.

Sub-periosteal fracture.

When a bone is fissured, and not displaced, the periosteum not being divided, there will be but little displacement; in children this condition is often found.

Crepitus.

Crepitus, or the grating sensation caused by the rubbing of the ends of the broken bones together, is a most valuable sign of fracture, and when detected, during the examination of a limb supposed to be fractured, the diagnosis is made clear, but when other symptoms of fracture sufficient for a diagnosis are present, it need not be looked for. In impacted fractures, as of the hip, it can only be felt on loosening the impacted fragments, and consequently by doing irremediable harm; this error is serious, and should be avoided. In incomplete fractures crepitus is also absent. In fact every fracture or suspected fracture should be manipulated with the utmost gentleness, in order that as little displacement and local injury may be inflicted as possible, for the bulk of fractures can be made out with certainty without crepitus. As a symptom, however, it is always of great value.

When not to be looked for.

Synovial crepitus.

The crepitus of effusion or of the thecæ of tendons must not be mistaken for that of a broken bone. It is a soft crepitus rather than a hard one, as in bone. Bursal crepitation is particularly liable to mislead.

When some swelling follows immediately upon the accident it means ruptured blood-vessels, arterial or venous. When it occurs within a few hours it is due to inflammatory effusion.

Caution.

In all cases of supposed displacement the normal condition of the limb must be inquired into, and the sound compared with the affected, for in more cases than one I have known a natural or old acquired deformity in a limb mistaken for one caused by an accident, and attempts have been made to restore, or rather to reduce the parts to their supposed normal condition.

Prognosis in simple fracture.

Prognosis.—Simple fractures, as a rule, do well. At Guy's, in six years, out of 469 cases of simple fracture of the thigh, 17 died, or 3·5 per cent.; of 888 examples of simple fracture of the leg, 8 died, or not 1 per cent.; of 123 cases of fractured patella there was no death.

The same statistics inform us that one tenth of all cases of fracture of the thigh are compound, and as are also one fifth of all fractures of the leg.

In compound.

Compound fractures are always serious accidents, those of the upper extremity being less fatal than those of the leg, and these less so than those of the femur. Thus, at Guy's, in six years, out of 94 cases of compound fractures of the arm and forearm, 16 or 17 per cent. died, or 1 in 6 cases; out of 202 cases of compound fracture of the leg, 56 or 27·7 per cent. died, or 1 in 4 cases; and out of 52 cases of compound fracture of the thigh, 19 or 36·5 per cent. died, or 1 in 3—the mortality increasing by 10 per cent. in each group. These statistics, however, but roughly indicate the risks of the different accidents, as they include smashes of limbs with the compound fractures.

Fat embolism.

As a cause of death after fracture of the long bones, Professor Czerny, of Freiburg, has proved in an able paper ('Berliner Klinische

Wochenschrift,' Nos. 44 and 45), that "fat embolism" is to be taken into account; the fluid fat of the bones being taken up by the veins and carried to the central organs—brain, lungs, and kidneys, &c.—and thus causing death. This result, he states, is a common cause of death when a bone is much fissured and the cancellous tissue laid open as in the V-shaped fracture of the tibia, and more particularly when this is compound. He does not inform us how this accident can be avoided.

Treatment.

Treatment.—The principles of the treatment of fractures are very simple, though the practice is often very difficult. To restore a bone to its normal position, and to keep it there by means of surgical appliances, or as John Hunter expressed it in 1787, "to place the parts in a proper position by art, that is, as near their natural position as possible, and keep them so" are simple rules to be observed, but to carry them out often demands the highest surgical skill and ingenuity; and yet the whole treatment of fractures is really comprised in these two indications.

Its principles.

Points to be learnt by an examination.

In examining a fracture, the greatest care is requisite, and only sufficient manipulation should be allowed to ascertain the *seat* of the fracture, the *line* of its direction, and the *tendency* a fragment may have to ride in any direction—this special tendency being the one point to be remembered in the treatment. These points, moreover, should be made out at the single examination prior to treatment; for repeated examinations whether by the responsible Surgeon or his assistants are to be condemned, as they can only do mischief by exciting more local irritation than is necessary, and adding to the injury which the muscles and soft parts have already sustained. For this reason, when after an accident, a fracture is suspected to have taken place, the Surgeon or bystanders should do no more than bind the limb to some immovable apparatus such as a wisp of straw, a bundle of sticks, or two pieces of wood fixed by a handkerchief, till the sufferer has been carried home and placed in a position in which he is to be treated. When the lower extremity is the affected part, the injured limb may be bound to the sound one, the latter acting as a splint.

At time of injury.

In compound fracture, the same precautions are necessary. Bleeding should be arrested by the application over the wound of a pad or bandage kept in position by means of pressure and the elevation of the limb, while in more severe cases the tourniquet or some local pressure over the main artery may be called for.

In field.

If these precautions are not observed on the field, many lives are lost from hæmorrhage, simple fractures are turned into compound, while compound fractures are made worse.

When on couch.

When a patient is placed in bed where he is to be treated, the fracture ought to be manipulated, and its *position*, *nature*, and peculiar *tendency* made out, and when made out to be "set," or put up, at once. The only exception to this rule is, when time has been allowed to pass before treatment is commenced and much œdema or swelling of the injured extremity exists, then it is better to fix the injured limb raised upon a pillow with a long sand bag on either side to act as a splint, and possibly a third round the foot, the pillow and side sand bags being firmly bound together by a strip of bandage and the whole forming an immovable apparatus. Mr. Aston Key, indeed, was so fond of this mode of putting up fracture of the leg that in my "dresser" days it was the usual mode of treating them all through their course,

Sand bags.

that is, for the first month or five weeks, till they could be put up in some starch or other immovable apparatus, and the patient allowed to get up. The method is comfortable and satisfactory to the patient, but it wants closer attention on the part of the Surgeon than can often be given.

Setting fracture.

In "setting" a fracture some care is needed, and the opposite and corresponding limb should always be before the Surgeon as a guide. Inquiries should also be made as to the condition of the limb before the accident, whether it was deformed or shortened from any previous fracture or disease, congenital or otherwise, for I have known an injured leg to have been likewise violently and unnecessarily manipulated to restore a supposed fractured bone to a position that it could not be made to assume on account of some natural deformity, and likewise a fractured thigh subjected to like rough treatment to bring it down to the level of its fellow, when an irremediable shortening existed from a former fracture.

Extension and counter-extension.

In extending a broken limb to restore the bones to their normal position, the upper portion should be firmly held by an assistant—to make *counter-extension*—and the muscles attached to it relaxed by placing the limb in a slightly flexed position; a second assistant or the Surgeon may then extend the fractured end, while the latter gently manipulates the fracture to make out its points. The extension should be steady and free from all jerks and violent movements, gentle lateral, rotatory, or other movements being given as required to restore the displaced portion of bone; the pressure of the thumb or finger being freely used to bring about an accurate co-aption or setting of the fragments; for the Surgeon must remember that muscular contraction is better overcome by *continued extension* than by temporary force, and that for the treatment of fractures generally, moderate extension continuously applied is preferable to forcible extension in any of its forms. The inhalation of chloroform at times is a valuable aid in the reduction of a fracture.

Chloroform.

Division of tendons.

If, when the fractured bones have been reduced, muscular spasm is so severe as to render it impossible to keep them *in sitû*, a condition which is not uncommon in fracture of the leg, the tendon of the offending muscle may be divided. In otherwise intractable fracture of the leg, there is no operation of greater value and attended with less evil than the division of the tendo Achillis. In a general way, however, the muscular spasm ceases after the first three or four days.

Splints.

When the fracture has been reduced, and by manipulation co-aptated or "set," splints or other mechanical appliances are necessary to keep the bones in their normal position, and the simpler these appliances are the better, so long as they fulfil their purpose. These splints should always be well padded, and the pads so adjusted as to fit into the inequalities of the limb, and protect it from any local pressure. They should be firmly and immovably fixed to the limb by inelastic straps or bandages and the seat of fracture as a rule, should be left exposed for the Surgeon's examination, in order that the fracture may be re-adjusted if displacement take place. To cover up a broken bone by bandages or splints is a mistake. The position of the bone during the progress of repair should be always open to view, the ormer practice being based on hope, the latter on certainty. Pott's rule, that the splints should include the joint above as well as below the fracture is sound, though it cannot always be followed. Every joint, however, should be fixed when by its action the broken bone is rendered movable.

When one bone is broken in a limb where double bones exist, the second acts as a splint and keeps up extension. Under these circumstances a simpler apparatus is required to keep the fractured bone quiet and restrain the action of the muscles that move it than under other circumstances.

Extension.

Extension is a valuable and necessary adjunct to other treatment, and should be kept up by means of weights, pulleys, or such other appliances as the ingenuity of the Surgeon may suggest. These means however, will be described in the treatment of special fractures.

After-treatment.

After the setting of the fracture, the essential point to be observed in its treatment is, the immobility of the broken bone; and next to this, its exposure to observation during the progress of repair to render certain that the bone has maintained its right position.

Treatment of compound fractures.

The treatment of compound is similar to that of *simple fractures*, plus the treatment of the wound with its complications and the broken fragments or projecting portions of bone, "but *rest* of the bone is the great object we have to aim at."—John Hunter, 1787.

Sealing of the wound.

These fractures should be "set" in the same way as the simple, great care being observed in the manipulation that the soft parts are not more injured; loose fragments of broken bone must be taken away, projecting portions excised, and the bone reduced, the wound being enlarged when necessary to facilitate this act; the injured parts, too, ought to be thoroughly cleansed and all wounded vessels twisted or ligatured; the bones should then be fixed immovably by means of splints, interrupted splints being often required. When the wound is not very extensive, it should be sealed by means of a piece of lint saturated with blood, or, with what is better, the compound tincture of benzoin. If the carbolic acid dressing is employed, the wound should be well washed with a weak solution of one part in a hundred, and dressed under the spray. The wound should be interfered with as little as possible, since now, as when the following words were uttered:—"The great mischief and bad success arising in the treatment of compound fractures is the dressing them every day and applying fresh poultices, which necessarily move the ends of the bones. *The limb if possible should never be moved.*"—John Hunter, MS. Lect., 1787.

Operative interference in compound fractures.

When the soft parts are much crushed, and the large vessels and nerves injured, amputation may be called for, more particularly in old subjects.

Skey's observations.

In compound fractures "scarcely any amount or form of fractured bone alone," writes Skey ('Operative Surg.'), "would justify the immediate resort to the knife if taken singly, even supposing the bone fractured extensively into a large joint; for in such a case, although anchylosis of the joint would probably occur, it would prove a lesser evil than that of amputation. Superadded to a compound or comminuted fracture of bone, the injury may be rendered yet more serious by extensive laceration of the muscles. In considering this latter condition much will depend on the kind of laceration, whether the muscles are merely cut asunder, or whether contused or torn, and whether this injury involves a few only or the majority of the muscles of the limb. Again, we must examine with great care the condition of the vessels. Is the main trunk whole? we might ask, in the supposed case of fracture of the thigh; or in that of the leg, is the posterior tibial artery torn? Is the limb colder than its fellow, or is the temperature considerably lower than the rest of the body? If so, probably one or more arteries are divided. What is the condition of the nerves? Does sensibility extend to the toes? If not, probably the nerve is divided also. If the evidence of the integrity of both artery and nerve fail, and the sinking temperature of the limb and the loss of sensibility continue to increase, we have no alternative but amputation."

Rule.

If a doubt exist in the mind of the Surgeon on the necessity of *immediate* amputation, he should wait, unless the patient be old, in which case let him act promptly.

Simple fractures into joints.

Simple fractures into joints require special treatment, as in a large number of cases although not in all, some impaired mobility of the joint will ensue; for this reason the joint itself should be placed at the most useful angle, and so fixed.

Compound fractures into joints.

Compound fractures into joints generally demand excision or amputation. In the *upper* extremity when there is any hope of saving the limb, excision is doubtless the better operation. In the *lower*, the expectant treatment is certainly better than excision, and probably better than amputation if the parts are not so injured as to render amputation at once a necessity, and if the age and general condition of the patient justify an attempt to save the limb; but these points will again have to be considered among the special fractures. In gunshot wounds these views are now generally entertained.

Fracture bed.

The Fracture Bed.—The best is, without doubt, a good horsehair mattress placed on a bedstead with a firm bottom; but where this does not exist, a board beneath the mattress is a good substitute. A canvas bottom, however tightly corded, always yields, and a feather or ordinary spring bed is not to be sanctioned. The woven wire mattrass is excellent.

The sheet covering the bed should be stretched and kept smooth several times daily so that no "ruck" takes place, bed-sores being more frequently caused by such than by pressure. In fracture of the lower extremity the head of the patient should not be raised too high, the use of one small pillow being ample.

Splints.

Splints made of wood, iron, felt, or perforated zinc may be employed, and the different forms will be given when the special fractures are considered. As a rule, the simpler in construction they are the better; and before adapting one to the broken limb it is well to fit it to the sound. The splints should invariably be quite clean.

Pads.

Pads.—All splints should be well padded and their edges carefully protected. The pads should consequently be well fitted, broad, and overlapping the sides. The best materials for these are tow or fine oakum, cotton, or sheep's wool, or, strips of thick flannel enclosed in a casing of soft linen or lint. The pads should be first fixed to the splint by tapes, or, by what is better, some pieces of strapping.

Immovable bandages.

Besides wooden and iron splints, the "immovable apparatus" for fractures is a very favourite one, and the material employed may be left to the fancy or convenience of the Surgeon.

In fractures of such single bones as the fibula or tibia where no displacement exists, their primary treatment by some immovable apparatus is very valuable, the limb being either put up at once before swelling has appeared, or as soon as the swelling, &c., has subsided. In other cases it is inexpedient to employ it for at least ten or fourteen days, until swelling has gone and a certain amount of repair taken place. In the fracture of long bones such as the femur, it is better to postpone its application until union is complete. Some excellent Surgeons, and among them Erichsen, employ the immovable apparatus from the very first. The mode of its application is as follows:—In all cases the limb should be cleansed and carefully dried, the bone itself being well protected by cotton-wool or a flannel bandage. The bandage with the stiffening material, is then to be prepared, and should be put on as smoothly as possible, no more "turns" being employed than are absolutely necessary.

Their application.

Splints of gutta percha, millboard, leather, Cocking's poroplastic, or hatter's felt, or perforated zinc, may be employed as additional supports when complete immobility is demanded. The first five materials, after having been cut to pattern, should beforehand be well softened by immersion in hot water or hot air and then moulded to the limb; the zinc should be carefully cut to fit it and well adjusted. These splints should be applied over the cotton wool or flannel bandage, and the prepared bandage then bound round. When *starch* is used (Seutin's bandage) it should be exterior, two or three coats being employed. The same may be said when the *white of egg* or *dextrine* is employed. When *gum and chalk* are used, the same mode ought to be followed, the mixture consisting of equal parts of finely powdered gum and chalk made into the consistence of thick paste by the addition of boiling water gradually stirred into it. This bandage is more solid than the starch.

Glue bandages.

Mr. De Morgan prefers the *glue bandage;* the best French glue, after having been soaked in cold water and melted in a glue pot, being applied like the starch; the addition of about one fifth of the bulk of the solution of methylated spirit hastens the drying.

Plaster of Paris.

When *plaster of Paris* is employed, the bandage should be of some loose texture and that made of book muslin or crinoline is probably the best. It should be prepared beforehand by well rubbing fresh dry powder into its texture, and should be made ready for use by being thoroughly wetted in a bowl of water for two or three minutes; some additional plaster being rubbed with water into the bandage as it is unrolled to strengthen the whole.

When the surface is extensive the setting of the plaster may be *delayed* by the addition of a little size or stale beer to the water with which it is mixed, while salt and the use of warm water increase the *rapidity* with which the plaster sets.

The day following the application of this bandage, a coating of flour paste, gum, or even a coating of varnish, may be applied to prevent chipping.

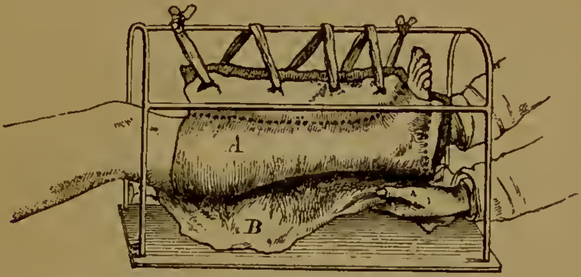
The Bavarian bandage.

In the appendix to the 'Army Medical Report' for 1869, Mr. Moffitt describes the Bavarian mode of putting up a fracture in an immovable apparatus, a mode which deserves to be more widely known than it is. I have tested it well, employing gum and chalk instead of plaster of Paris, and can strongly recommend it; being simple, it can be applied very quickly, and is most effective. It is now in general use

Its mode of application.

at Guy's, and is applied as follows:—The materials required to make it are, a piece of stout, "coarse house-flannel," which has been shrunk, some precipitated chalk, mucilage of gum acacia, a good-sized cradle, and a stout needle and thread. When it is applied to the leg for fracture, two equal-sized pieces of the flannel are first cut, long enough to reach from the lower border of the patella to three inches below the heel, and, in breadth about six inches more than the circumference of the calf, so as to allow the edges to overlap for about three inches when the flannel is folded round the leg. One of these pieces should now be applied to the leg, its centre corresponding with the centre of the calf; and its two flaps brought tightly together over the skin (Fig. 476), where they should be firmly stitched together, the stitches being inserted close to the bone. The stitching must be begun at the upper part, carried down to the hollow of the instep, and then fastened off. Having arrived at this point, the next thing is to see that the foot is at a right angle with the leg; if left alone it will probably be at a very obtuse angle, and considerable force is sometimes necessary to bring the toes up, which must be done now or not at all. The stitching must next be begun on the sole of the foot, commencing at the toes and proceeding towards the heel, the flannel being tightly dragged downwards.

Fig. 476.



Bavarian or immovable splint.

A. First layer of flannel applied to limb. B. Second layer about to be applied.

Bavarian splint.

The stitching along the sole of the foot being completed, the remaining piece along the dorsum of the foot may next be stitched, and after this there can be no fear of the foot changing its position.

The limb will now be tightly encased in a layer of flannel, the edges of which are lying in adaptation in front of the leg. The flannel along the sole of the foot to within an inch of the stitches should next be cut off, and the edges turned back. At present the superfluous flannel along the front of the leg and dorsum of the foot should not be interfered with, but the limb slung up to the cradle by three or four pieces of bandage, pinned or stitched to the adapted edges of flannel in front of the leg (Fig. 476). This will have the effect of stretching the flannel, and making it more closely adapt itself to the shape of the calf, ankle-joint, &c., and allow the gum and chalk to be easily applied. The next thing is to make a thick paste of the gum and chalk, the consistence of honey, by stirring them together in a basin, which should be spread thickly over the surface of the flannel with a brush, or rubbed in with the palm of the hand, care being taken that it enter all the little inequalities of the flannel. Having done this apply the outer layer of flannel, placing it just as the first was placed, with its centre corresponding with the median line of the calf, folding its edges closely around the leg, and bringing them up together in front over the edges of the previous layer. Keep them also in position in front by about half a dozen stitches, put through at intervals down the leg close to the shin. Along the sole of the foot this layer of flannel may at once be neatly finished off by turning in the edges and joining by stitches. The whole should now be left suspended to the cradle for about twenty-four hours to dry, at the end of which time it may be taken down, and the splint removed from the leg by cutting up the stitches along the front of the leg and dorsum of the foot with a pair of scissors, aided by forcibly separating the adjacent edges of flannel.

Binding splint.

It now only remains to trim up the splint by cutting off the superfluous edges, binding them with strips of leather made adhesive by being spread with resin plaster, and inserting eyelet-holes at equal distances all down, so as to lace the splint up the front (Fig. 476A).

For knee-joint.

If the splint is required for a *knee-joint* some modifications of the above plan is necessary. It will not do to suspend the limb to a cradle by the edges of the flannel, as in the previous case, but the patient should be seated in a chair before a fire with the heel resting on another chair. Then the first layer of flannel should be tightly applied, its edges being brought up together in front, and stitches inserted close to the leg. The gum-and-chalk paste may now be thickly spread over the surface of this flannel and covered in by a second layer of flannel, exactly as in the previous case. This second layer may be fastened in front by a few stitches, and the whole allowed to dry. When quite dry the adjacent edges of flannel may be forcibly separated, and the stitches divided with scissors. Lastly, the superfluous edges may be cut off, two semilunar pieces cut out for the patella, the margins bound with leather, and eyelet-holes inserted for lacing up in front. To apply the splint to the *hip-joint* it is necessary that the first layer of flannel should surround the pelvis as high as the crests of the ilium, and also the affected thigh. It should then be stitched along the outer side in one continuous seam, and the superfluous edges allowed to remain in apposition. The gum-and-chalk paste must then be applied, some difficulty being probably experienced in applying it over the sacrum, but the patient must be rolled first to one side and then to the other. While this is being done the second layer of flannel should be lying underneath, so as to protect the bed, which may then be adapted and fastened closely by a few stitches along the line of the previous sutures. When the whole is dry it may or may not be found necessary to rip it up, and insert eyelet-holes. If the splint fit closely, without causing any undue pressure, the edges may be cut off close, and the whole allowed to remain as it is, but for the sake of cleanliness, especially in children, it is generally better to cut up the stitches along the outer side, bind the edges with leather, and lace it up, so as to allow the splint to be removed as often as requisite.

For hip-joint.

When extra stiffness is required in any of these splints the inner surface of the second layer of flannel may be covered with the chalk paste before it is applied, some strips of tin, or a piece of gutta-percha which has been moulded to the part should be introduced between the two layers of flannel.[1]

Mr. Croft has suggested a very excellent modification of the Bavarian, which is much used. It is made as follows:

Croft's splint.

To make the splints.—1. A piece of house-flannel, or an old shrunk blanket, or any suitable substitute, is selected. The pieces may be shaped by measurement, taking the circumference of the limb above and below the knee, at the biggest part of the calf, just above the ankle-joint, from the front of the ankle-joint round the heel to the front again, and at the middle of the metatarsus. The flannel of each splint should be in width half an inch less than half the circumference at any of those points. The width of the two splints should be one inch less than the circumference of the limb at any corresponding part; it should be long enough to extend from above the knee to the middle of the metatarsus. Four pieces are required—two for each splint. 2. Two bandages of common muslin are prepared, each five to six yards long and two inches and a half in width. 3. A handful or two of good dry plaster is mixed with water to the consistence of thin cream. 4. The inside pieces of flannel may be laid on the table or bed, the outer surface being upwards. 5. The outside pieces are to be soaked in the plaster separately, and laid out on their respective inside pieces.

Its application.

Application.—Whilst traction is kept up and the ends of the broken bones are maintained in apposition, the splints are to be applied and smoothed; then the bandage is to be put on. Traction is to be maintained during the hardening of the plaster. The latter takes place in about three minutes. Next, the limb should be laid on a large, soft pillow, the toes directed upwards, and the knee a little bent. In the application of the bandage great caution should be observed that it is not drawn tightly anywhere, and that no one turn of the bandage is tighter than another. The support is to be equal everywhere. The two splints should not meet by about half an inch either down the front or back. The intervals are spanned by the dry porous muslin; at the sides the bandage is fixed to the splints by the plaster, which oozes into it from the outer layer of flannel. If it become necessary next day, or later, to ease the splints, or to inspect the limb at any spot, the bandage can be slit up with scissors along the middle line in front. One or both of the splints can then be eased from the limb, and readjusted by the addition of another bandage. It is undesirable to wholly remove the splints. They are hinged together at the back by the muslin bandage which spans the interval there. The trimming of the apparatus may be done as soon as the plaster shall have hardened. Should the Surgeon be short-handed with regard to assistance, he may apply the outside splint first, and lightly bandage that on; and when that splint has nearly hardened he may put on the inside one. As swelling subsides, and the splints become more or less loose, an additional bandage should be put on. At the end of ten days, if the patient be convalescing, the outside bandage may be gummed, or a fresh gummed bandage rolled on. That apparatus will last until splints are no longer needed. At the end of a fortnight or three weeks, as the case may be, the patient may leave the hospital for his own home.

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[1] I am indebted to a valued pupil, Mr. W. H. Harsant, for the above description of the splint.

This mode of treatment is admirably adapted to oblique fractures, accompanied by displacement of the tibia, to cases of Pott's fracture, and to comminuted fractures.

In cases of compound fracture an opening suitable to the wound may easily be made. This splint is as good for joint cases as for those of fracture; indeed, it is by far the best immovable apparatus we possess.

Hyde's felt splint.

Mr. Hyde, of Mortimer Street, has introduced a "leather-felt splint" of great value, which is readily applied, is light and strong, and rarely requires to be used with starch. Cocking's poroplastic splint answers the same purpose, the splint becoming soft on immersion in hot air or water, and hard again within a few minutes of its removal. If, when moulded, it fails to fit exactly, it can be softened locally by the application of a hot-water sponge.

Paraffin.

Mr. L. Tait ('Med. Times,' 1865) has suggested the use of paraffin for the same purpose, the melted paraffin being kept liquid by the immersion of the bowl containing it in hot water, the bandage as it is being applied being made to pass through the liquid paraffin, melting at 105° to 120° F. Two or more coats of paraffin may be painted over the whole.

Silicate of potash.

The liquid glass, *silicate of potash,* may also be used, the solution being painted over the bandage with a brush. I have used it, and like it, but not so much as the splint I have described.

Contraction on drying.

By way of caution it should be stated that all starch, chalk, and plaster-of-Paris splints contract on drying, and from such contractions I have known harm, and even gangrene to follow. To guard against this contingency, when bandages are used, cotton wool should be applied freely around the limb; although in the Bavarian splint this precaution is not called for.

On this account the practice of using these splints, as a primary application in the treatment of fractures is dangerous; for when swelling to any extent takes place the pressure may be most harmful.

When pain or swelling of the limb follows the application of any of these splints, they should be at once removed, the whole being cut up, with strong scissors from end to end, eyelets being subsequently introduced for laces to draw them together again, or, straps and buckles may be employed.

Repair of fractures.

Repair of Fractures.—In children broken bones repair rapidly, four weeks being ample time for the whole process to be perfected, while in the aged, ten weeks or more may be needed. Repair goes on more rapidly when the broken ends of the bones are placed and kept in position than when they are apart or not kept at perfect rest. When bones are maintained accurately in position or are impacted, direct union ensues as in the soft parts, but when movement is allowed, reparative material is poured out around the broken fragments, and the provisional callus of authors, or the ensheathing callus of Paget, is formed, which, acting as a temporary splint, keeps the bones in position till they unite by means of the permanent callus. The best repair of a fracture is the direct, and when provisional callus exists some mobility of the broken bone has been allowed, to a certainty. This addition to our knowledge is due to Sir. J. Paget, for until his day, a provisional callus was always looked upon as a necessary means for the repair of every fracture. We now know it is only present when mobility of the fragments interferes

Provisional callus.

with direct repair, and, in proportion to the amount of provisional callus, may the extent of mobility be estimated.

Effusion of blood.

Laceration periosteum.

When a bone is broken, blood is effused, the amount depending upon the degree of injury to the soft parts and the amount of comminution of the bone; it is exceptional to find blood between the broken bones. In simple fracture the periosteum may be only torn across; in the comminuted it is more extensively injured, while in incomplete fractures it is probably always entire.

Reparative products formed by periosteum and endosteum.

After a simple fracture some slight inflammatory exudation may be poured out around the broken bone, which in healthy subjects is very limited and unattended by any constitutional symptoms. In more complicated cases or in cachectic subjects, the effusion may be extensive, and constitutional symptoms with febrile disturbance severe. Under favorable conditions, this inflammatory material will be absorbed with the effused blood. The true reparative material is poured out about the sixth or ninth day, and, when no displacement exists, it will be effused only between the ends of the broken bones; when, however, the bones are comminuted it will be more diffused. When they are misplaced, it will be still less defined, and when the periosteum is much separated or torn, it will be poured out around the bones as a provisional callus. The true reparative products are chiefly poured out by the periosteum and endosteum, though the soft parts around at times add their quota. In the flat bones, the ossification of this reparative material has a preliminary fibrous tissue stage, and in the long after the blood has been absorbed, the cell infiltration passes on to the formation of connective tissue or *neoplasm* which subsequently ossifies, in rare cases passing through the stage of fibro-cartilage. In children, it is probable that the cartilaginous stage always precedes the osseous, while in adults, the bone is poured out at once, which is probably always the case in all rapidly repairing fractures.

Ossification may take place in the periosteal blastema or in the endosteal or in both—these points being greatly determined by the relative position of the broken ends of the shaft of the bone and the comminution of the fragments; great displacement and separation of the fragments being bridged over or cemented together by irregular masses of connecting bone tissue.

Fibrous union.

When immobility of the broken bones has not been maintained, the bone cement or provisional callus will be very extensive. In the ribs where it is impossible to prevent movement, there is always some ensheathing callus; indeed, Dupuytren's ring of provisional callus is constant. In the clavicle also it is common. In other bones, it will vary with the amount of movement that has been allowed in their treatment. When the movement is very great, the process of ossification will not go on kindly, and ligamentous or fibrous union will remain, giving rise to an ununited fracture, and occasionally a false joint is formed. (A splendid example of this is represented in Fig. 477.) The rapidity with which ossification or true bony union is obtained in fracture depends much on the degree of immobility insured to the broken bones and the constitutional power of the patient.

Stages of repair.

The periods in which the several parts of the reparative process are usually completed after fractures of adult human bones are reckoned thus according to Paget:—To the second or third day after the injury, inflammation in and about the parts; thence to the eighth or tenth seeming inaction, with subsidence of inflammation; thence, to about the twentieth, production of the reparative material, and its gradual development to its fibrous or cartilaginous condition; thenceforward its gradual ossification, a part of the process which is most variable both as to time of commencement and rate of progress, and which is probably rarely conpleted before the ninth or tenth week.

Repair in compound fractures.

In open or compound fractures, repair goes on very much in the same way as in simple; when they are made simple by sealing the wound, precisely the same process goes on. When the wound is left open and suppuration takes place in the soft parts around the broken fragments, repair goes on through granulation, the granulation tissue subsequently ossifying and passing into bone-cells; the process of repair under these circumstances is thus more gradual than where the reparative material is poured out between the broken bones, and proceeds directly to ossify.

At times after a simple fracture, but more commonly after a compound, the fractured bone inflames, and, as a result, the broken fragments die wholly or in part, repair is retarded and cannot be perfected until the necrosed bone has been cast off or removed. In comminuted compound fracture, this result is more common than in less complicated cases. In gunshot injuries of bones this comminution of the bone is the chief point of difference between them and other compound fractures.

Compound fractures, as a rule, require for their repair three or four times the period required in simple.

Ununited fractures.

Causes.

Ununited fractures are met with, when, from any local or general cause, ossific union is delayed or does not take place between the broken ends of the bones, and in by far the bulk of cases, this is the result of a want of that complete rest and quiet which is so essential for the ossific union of a broken bone. When the ends of the broken bone are kept asunder, ossific union is likewise sure to be retarded or prevented, and also when any muscle or fascia is placed between the broken fragments. In feeble cachectic and syphilitic subjects the same want of repair may likewise be met with.

Failures in the reparative process depend therefore on some failure in the general power of the patient, want of care in the local treatment of the case, or on some local cause. The union, however, is, as a rule, simply delayed.

Statistics.

Most frequent seat.

Hamilton calculates that such delayed union occurs once in 500 cases, but this average I believe to be too high. It is chiefly found, according to Norris ('Amer. Journ. of Med. Sciences,' 1842), in the thigh, leg, arm, forearm, and lower jaw. I have seen it, however, in the clavicle and in the ribs, and cases are recorded in which it was met with in the spine.

In the majority of cases, the union of the broken bones is by fibrous tissue which has failed to ossify. In Prep. 1110^{80}, Guy's Museum, this condition is well exemplified, the ends of the bone being pointed and firmly joined by ligamentous tissue. The length of this tissue varies in different cases. In exceptional instances, the ends of the bone are rounded and enclosed by a strong capsular ligament, and thus a false joint is formed, which is well exemplified in a specimen of fracture of the forearm (Guy's Museum, 1119^{20}), but still better in that of the humerus (Prep. 1110^{85}), Fig. 477, in which the ends of the bone are studded with fibro-cartilage, and complete movement existed.

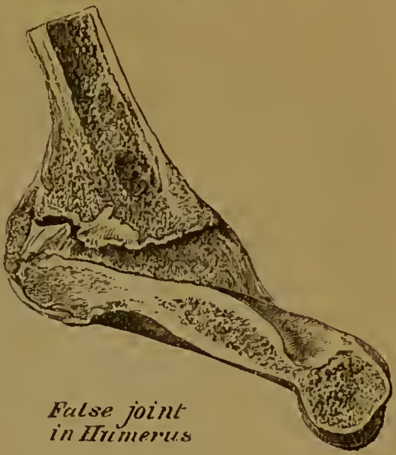
In more rare cases there is a total absence of all uniting medium.

Treatment.

Immobility.

TREATMENT. — Regarding a large majority of cases of ununited fracture, as examples of delayed union, due to a want of that absolute immobility of the fractured limb which is so necessary for its repair, the most essential point to be observed in treatment is, the application of an absolutely immoveable apparatus, which may be found in one of the forms of splint described as immoveable, such as that of starch, egg and flour, chalk, plaster of Paris, or liquid glass, with gutta percha, millboard, zinc, or felt; the joints above and below the broken bone being included in the apparatus, while tonic treatment is at the same time observed.

FIG. 477.



Prep. 1110^{65}, Guy's Mus.

When the limb is thus firmly fixed, rest and the non-use of the limb is scarcely necessary; indeed, under certain circumstances, the moderate use of the limb seems to be beneficial, and in several cases under my care, repair seems to have been hastened by such a licence. John Hunter saw the truth embodied in these remarks, having asserted in 1787: "When the uniting process in fracture is backwards, the parts should *not* be kept at perfect rest. I have seen fractures of the leg which would not otherwise unite, do so after patients were up on their legs, the fractured bones being well supplied with iron splints, &c." (MS. Lect.). When these means fail, the ends of the bone may be well rubbed together to excite action before the reapplication of splints, or subcutaneously scored with a tenotomy knife, while in still older cases the bones may be fastened together by means of wire sutures, or drilled and secured with ivory pegs, the credit of this latter suggestion being due to Dieffenbach. Dr. Physick, of New York, years ago (1804) suggested the introduction of a seton between the ends of the broken bones, and Norris reports that good success has followed the practice, 54 out of 72 cases being successful. The object of the treatment is to excite local action between the fragments, and when this is secured, the seton may be removed. With the same view Malgaigne introduced acupuncture needles between the bones, and Miller and M. Blandin subcutaneously scraped with a tenotomy knife the ends of the bones or the connective tissue.

Resection only exceptionally required.

Resection has also been practised, and, according to Norris, with success in thirty-seven out of sixty-four cases. The operation, however, is formidable, and should only be undertaken where there is no hope of minor measures being successful, the ends of the fragments being far apart, and the condition of the limb such as to render some risk justifiable to gain the desired end. I have performed this operation for ununited fractures of the femur and humerus with excellent results, in some cases wiring the bone together.

Bigelow's operation.

Dr. H. J. Bigelow, of Harvard, has, however, met with considerable success in detaching the periosteum for about half an inch from the extremities of the affected bone with the muscles, taking off the ends of the bones and securing the resected portions together by strong wire passed through half the thickness of the shaft of either fragment; the periosteal flaps may also be united by sutures. The limb should then be fixed on a splint. The wire can be left in place without fear from two to six months. He cured ten out of eleven cases where this operation was performed. ('American Journ. of Med. Sciences,' 1867.)

Union becoming disunion.

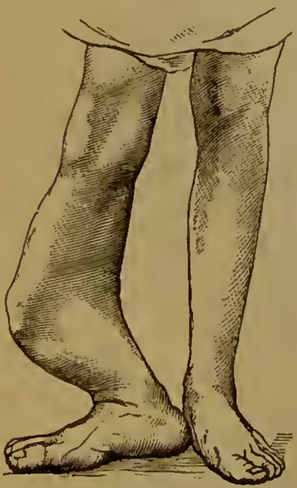
It occasionally happens that a fracture which had united becomes disunited after fever, scurvy, or other enfeebling cause, and I have had one very marked case of this in the person of a young lady who had her thigh fractured abroad, and subsequently became the subject of tropical fever. In her case, although the bond of union completely gave way, she subsequently obtained a firm limb by means of local immobility and constitutional tonics. These cases ought to be classed with others in which the cicatrices of burns or old ulcers break down under some enfeebling influence, and heal under tonic and general hygienic treatment. In the treatment of all these cases time ought not to be estimated too closely.

Deformity after union.

Treatment.

The *deformities that follow badly united fractures* require at times surgical treatment, and, when the Surgeon is consulted during the first few weeks of the case, an anæsthetic should be given and the bone refractured and set in a good position—it being quite justifiable to employ considerable force to attain this end. In young subjects, this refracture is rarely attended with difficulty, though in the adult it is. Œsterlen and Skey were strong advocates for this practice, the former having employed it up to the twenty fourth week, and the latter on a boy, æt. 15, thirteen months after the fracture.

Fig. 478.



Hyperostosis of the tibia.

Osteotomy.

When the bone has united too firmly to permit of refracture, it should be divided by a subcutaneous section, or, by some cutting operation. Key did this latter operation in the leg in 1839 ('Guy's Hosp. Rep.,' series i. vol. iv). The subcutaneous section should be performed in a similar way to that adopted by W. Adams, in dividing the neck of the thigh-bone with a saw or chisel.

These operations, however, are only to be undertaken when the local deformity is great and the limb useless.

In the incomplete or green-stick fractures of infancy, if the bone be not straightened, strange deformities ensue. In the case depicted in Fig. 478, such a result was to be seen, the bent tibia and fibula having been much thickened by the deposition of bone in the concavity of the arch, the bone measuring across its centre six inches. It was taken from a girl, twelve years old. I am now disposed to think this case was really one of hyperostosis of bone which may or may not have followed a fracture.

SPECIAL FRACTURES.—FRACTURES OF THE UPPER EXTREMITY.

Fractures of the cranium and spinal column have already received attention; those of the lower jaw have been described in page 554, Vol. I, and those of the nose and sternum in Chapter XVII.

Of clavicle.

Statistics.

Fracture of the clavicle is generally the result of indirect violence such as a fall upon the shoulder, and when of direct it is usually compound or comminuted. Hamilton and Gurlt record examples from muscular action, and I have seen one in a man æt. 44 (who had had syphilis nine years before), from simply lifting a heavy weight from the ground. The bone broke near the sternal end with a snap, and a good recovery followed. The case was brought under my notice by Mr. Couling, now of Brighton, when house-surgeon at Guy's. The statistics of the Middlesex Hospital, as compiled from the experience of sixteen years, by Messrs. Flower and Hulke (Holmes's 'System,' vol i., 3rd Edit.) prove the clavicle to be more frequently broken than any other single bone, the radius standing next in order, although, including fracture of the radius with the ulna, the fracture of the clavicle stands second. Half the recorded cases occurred in children under five years of age.

Seat.

The bone as a rule, is broken about its centre, and the line of fracture with rare exceptions is oblique from without inwards, and from before backwards; the inner fragment having commonly a tendency to ride over the outer, the outer falling downwards and backwards.

Fractures at either extremity also occur and one of the sternal end when vertical may be mistaken for a separation of the body of the bone from its sternal epiphysis; when oblique, downwards, or upwards, such an error can hardly occur.

Symptoms.

The *symptoms* are generally well marked. There will be inability to move the arm freely, with pain in the attempt, the patient supporting the arm of the affected side. On comparing the shoulders of the two sides, the joint on the affected one will be placed lower and more forward than on the sound side, and at the same time will be drawn nearer to the median line of the body, even to the extent of an inch when the displacement is great. On passing the finger over the broken bone some depression and corresponding elevation of the broken fragments will be detected, and when the examination is made after the expiration of days there will be also effusion of much solid material. *Crepitus* can sometimes be detected, but it need not be looked for—this symptom, with the amount of displacement, depending much upon the line of the fracture and its situation.

Fracture of acromial end.

Dr. R. Smith, of Dublin, points out ('Treatise on Fracture,' 1850), how in fractures of the acromial end of the bone between the conoid and trapezoid ligaments, there is scarcely any displacement of either fragment; and, under these circumstances, the diagnosis has to be made by the pain produced on pressure over the broken point, and the crepitus educed by the movement of the bones in opposite directions through the fingers. He also shows, how in fracture external to the trapezoid ligament, the inner fragment being drawn upwards by the trapezius muscle, the displacement is great.

In children, *incomplete* fractures of this bone may occur (Fig. 473).

May be compound and comminuted.

Fractures of the clavicle are sometimes comminuted and compound, and occasionally complicated with some severe injury to the vessels beneath. In the case of the late Sir R. Peel, the accident was followed by a pulsating blood tumour which was supposed to have been due to a rupture or laceration of some large vein, probably the subclavian, while from the severe pain that attended the injury, some of the nerves of the brachial plexus were believed to have been injured. Mr. Erichsen has recorded ('Brit. Med. Journ.' June 7, 1873) a case, in which the subclavian vein was compressed by a fragment of a broken clavicle, and in which amputation of the shoulder-joint was performed on the sixteenth day, and I have seen one in which a broken clavicle was followed by arrest of pulsation in the artery of the corresponding arm. At St. George's Hospital, there is a specimen in which the end of the fractured bone was driven through the internal jugular vein.

Fractures of both clavicles have also been recorded. I have seen this more than once in children.

Treatment.

TREATMENT.—Daily experience proves that fractures of the clavicle unite without any treatment; and, moreover, palpable deformity too often shows that where treatment has been employed the union is neither perfect nor satisfactory. Daily experience likewise proves, that in most, if not all cases of fracture of the clavicle, the bones fall well into place on the patient assuming the recumbent position. In young ladies, and in others where it is a matter of importance to prevent deformity, the recumbent position in bed may be maintained for about three weeks, till union has fairly taken place; but children and men will rarely be found willing to follow such a line of treatment, and happily it is not required, for nearly, if not quite, equally good results will be secured by imitating what takes place on the patient assuming the recumbent position, viz. by fixing the lower blade of the scapula to the chest, binding down its angle to the thorax, and thus preventing the tilting forwards and rotation of the bone through which the deformity takes place.

Binding scapula to thorax.

The plan I have now adopted for some years is, to place a pad over the blade of the scapula below its spine, and to bind the bone firmly to the thorax by means of broad strips of strapping obliquely encircling half the chest from the spine to the sternum, at the same time supporting the affected arm in a sling, and drawing the hand upwards towards the opposite shoulder. The same method is also advocated by Dr. E. Hartshorne, of Pennsylvania. Whilst the strapping is being fixed, the scapula should be well tilted backwards by elevating the arm, or the patient should be kept in the recumbent position. When this practice cannot be followed the elbow should be brought forward to a point below the nipple of the affected side, and the hand drawn over the opposite shoulder. The old plan of fixing the pad in the axilla and using a figure-of-eight bandage has no advantage, and, moreover, causes much discomfort to the patient.

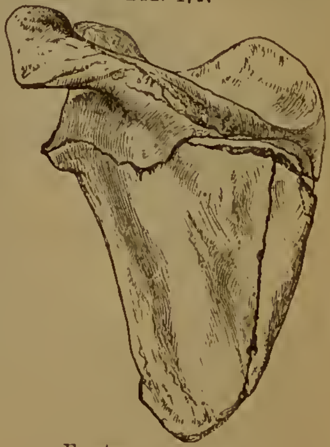
The axillary pad of Desault is at times serviceable, and may be employed, being easily fixed by a broad piece of strapping made to encircle the shoulder. In addition to the pad, Professor Gordon, of Belfast ('Dublin Quart.,' 1859), recommends the injured arm to be extended downwards, and firmly fixed to the body by a bandage; permanent extension being kept up by means of a band fastened above to the forearm, flexed at right angles, and below, around the perinæum or upper part of the thigh.

Sayre's method.

Sayre's method, applied as follows, is certainly valuable:

Take two strips of adhesive plaster, two and a half inches wide for an adult. Pass one strip around the arm at the junction of the lower and middle third, one end of the strip being united behind the arm to the same strip which is to be passed around the body, making a loop and leaving an open space at the posterior part of the arm. This loose loop arrangement prevents strangulation. Then draw the arm back, to bring the pectoralis major muscle upon the stretch; but the acromial end of the clavicle still rides under the sternal fragment or end. Now secure the arm back by passing the long end of the strip of adhesive plaster around the body, bringing it two or three inches under the arm of the opposite side, across the thorax, and fastening it to itself somewhere about the middle of the back. Care must be taken not to draw the arm too far back, but just sufficient to put the pectoralis major on the stretch. Then take the other strip of adhesive plaster, and make a slight longitudinal slit in the centre, to admit the point of the elbow; flex the arm at an acute angle over the chest, drawing it upward, forward, and inward, and thus reduce the fracture. After bringing both fragments of the bone into a direct line, secure the arm in this position by first placing the centre of the elbow in the longitudinal slit in the adhesive plaster, passing one end of the strip across the back, diagonally to the opposite shoulder; then bringing the anterior end of the strip up along over the flexed arm and the hand, over the chest, and fastening it to the posterior end of the strip at the shoulder. If this plan be carried out carefully it will yield a perfect result without deformity.

Fig. 479.



Fracture of scapula.
Prep. 1097^{20}, Guy's Mus.

Scapula.

Fractures of the scapula, probably, are always the result of direct violence, although a fracture of the neck of this bone may be produced by a fall upon the shoulder.

Seat.

The *body* of the bone may be fissured in any direction (Fig. 479), though much displacement is rare.

Symptoms.

In this accident mobility of the broken bone and crepitus may usually be made out by manipulation; though in fat subjects, and when effusion exists, the diagnosis may be difficult.

Treatment.

Treatment.—A broad pad carefully adjusted, and kept in position by means of broad strips of plaster encircling half the thorax, the arm being kept quiet, and the elbow raised in a sling, is usually sufficient treatment, although a good shield of gutta percha or felt may be sometimes beneficial.

Of acromion process.

The *acromion process* may be fractured across its base or in any other part, and when it is so the outer fragment is generally drawn downwards with the arm, producing a dropping of the shoulder. The accident can readily be made out, on tracing the spine of the scapula outwards, by the deformity, the break in the normal line of the bone, and the local pain, if not by the separation of the fragments. There is also loss of power in the arm, and alteration in its outline.

It should be treated by raising the elbow by means of a good sling or bandage, a small axillary pad and a circular bandage binding the arm to the thorax. The union, however, is often ligamentous, it being impossible to keep the fragments of bone closely in apposition.

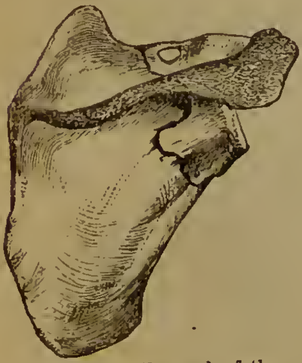
Of the coracoid process.

Fractures of the *coracoid process* are remarkably rare. I have seen but one decided instance, and that in a girl, æt. 15 or 16, the result of a blow. There was local pain and crepitus to denote the injury with displacement of the process, the point of which was drawn downwards by the biceps muscle, and its base projecting. Dr. Pauli, of Luton, kindly gave me the notes of a case that occurred in a girl, æt. 14, from a fall on her shoulder. There was marked mobility of the coracoid process and crepitus, but no deformity. There was pain in the part, increased by any movement of the arm. This accident is more commonly associated with dislocation of the humerus.

Treatment.

TREATMENT.—The muscles attached to the process must be relaxed, the biceps by flexing the forearm, and the coraco-brachialis by drawing the arm forwards and inwards. In this position the arm should be bound by a bandage, the bone itself, if possible, being restored to its normal position by manipulation.

FIG. 480.



Fracture of the neck of the scapula.

Of neck of scapula.

Fractures of the *neck of the scapula* or of the *glenoid fossa* must be rare. Sir A. Cooper described such cases, but since Malgaigne showed how the symptoms described might be produced by dislocation of the shoulder with fracture of the glenoid cavity, some doubt has been thrown upon the question of a simple fracture of the neck of the bone ever occurring. In Guy's Museum, prep. 1097^{85}, there is a specimen of fracture of the neck (Fig. 480), and in the Royal College of Surgeons there is a second, the third being recorded in Du Verney ('Traité des Maladies des Os,' 1751). Sir A. Cooper gives the flattening and sinking of the shoulder, the prominence of the acromion, the elongation of the arm, and the presence of crepitus, as the chief symptoms, the head of the humerus being felt in the axilla. He also relates how the arm may be replaced in its normal position and again displaced on allowing the arm to drop, this symptom being the chief one of diagnosis between the supposed accident and dislocation, but, when dislocation of the head of the humerus exists with fracture of the glenoid fossa, the same symptoms are found. The subject, therefore, requires further elucidation. In sus-

Symptoms.

pected cases of this kind the elbow should be raised, in order to press the head of the bone well upwards into position, and kept there by sling and bandage.

Treatment.

Case.

I have seen a case of dislocation of the head of the humerus downwards and forwards, complicated with a fracture of the lower portion of the glenoid cavity, the broken piece being drawn downwards.

Fractures of humerus.

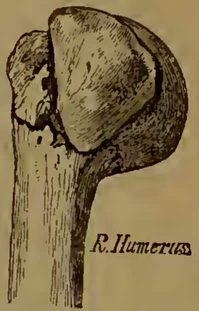
Fractures of the humerus form about one seventh of all fractures, and are about half as frequent as fractures of the clavicle and scapula together. They are commonly the result of direct violence, and occasionally of muscular action. They may be divided into fractures of the *head* and *tuberosities*, *shaft*, and *condyles*.

Fracture of head and tuberosities.

Causes.

Fractures involving the *head* and *tuberosities* are usually the result of a blow or fall upon the shoulder, although occasionally they follow falls on the elbow. In a case that came under my care in 1877 and died from other injuries, the greater tuberosity was crushed off and displaced upwards from a fall upon the shoulder. This accident could never have been made out during life. In all cases, the direction of the violence is an important point to discover, as by it the Surgeon obtains the best guide to the position of the fragments as well as the nature of the injury.

Fig. 481.



Fracture of the head and tuberosities of the humerus. Poland's case.

At anatomical neck.

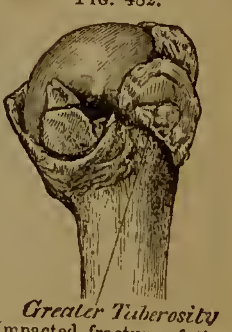
When the line of fracture follows that of the *anatomical neck*, it is intracapsular; and when this occurs, the head of the bone may be completely separated and left as a foreign body in the joint; yet such cases are very rare. In others, such as Fig. 481 illustrates, the head is separated and the tuberosity fractured; more commonly, however, the fracture is *impacted*, the lower fragment being either driven into the head of the bone, or the head driven into the neck, the greater tuberosity, as a rule, being broken (Fig. 482).

May be impacted.

Symptoms.

Dr. R. Smith, of Dublin, states that when this accident exists, the arm is shortened, the acromion process projects, the shoulder loses its rounded form, the shaft of the humerus approaches the acromion, and the head of the bone cannot be felt. When the tuberosity is broken off, crepitus may be detected.

Fig. 482.



Impacted fracture of the head of the humerus. Prep. 1113⁵⁰, Guy's Mus.

In 1868, I saw such a case in a woman, æt. 59, who had fallen on the shoulder nineteen days previously, the case having been treated as one of contusion. Shortening in the arm of three quarters of an inch, and a distinct prominence of bone with thickening could be felt between the acromion and coracoid processes; while the head of the bone rotated freely in the glenoid cavity. In it, there was some flattening of the deltoid. A good recovery took place with permanent shortening.

I saw also a similar case in 1865, in an old man, æt. 82, in which good repair took place.

More commonly a fracture about the head of the bone means a

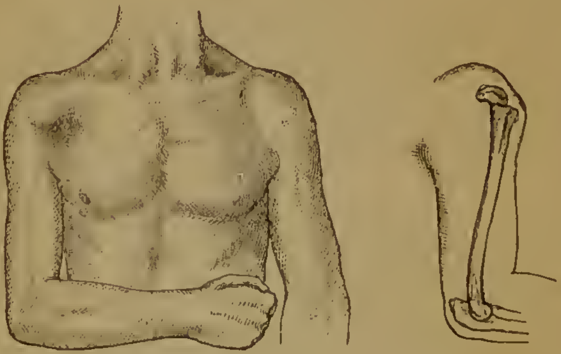
Fracture or separation at epiphysial line.

Cause.

Symptoms.

fracture in the line, or a separation of the epiphysis, the epiphysis including the head and the tuberosities. This accident is generally the result of a fall on the elbow, and the symptoms of the accident are tolerably distinct. The head of the bone can be felt in its normal position, but is not movable on rotating the shaft, while the end of the displaced shaft is usually sent forward. When fractured, the bone presents a sharp edge and outline; but when displaced—an accident that can only occur in subjects under twenty-one—the end of the bone appears rounded and slightly convex. It is, moreover, drawn forward by the action of the pectoral muscles, and made to project beneath the coracoid process in a marked and characteristic manner. In Fig. 483, taken from a male patient of mine, æt. 16, this position is well seen.

Fig. 483.



Separation of shaft of humerus from upper epiphysis.

When complete.

When partial.

When the separation is complete, the displacement will be very marked. When partial, it will be equally characteristic, but, in partial displacement of the shaft, some mobility of the head of the bone will exist. In this accident the shaft may be at times replaced by manipulation, "but the moment the parts are abandoned to the uncontrolled action of the muscles the deformity recurs."—*R. Smith.*

May simulate dislocation.

When, after a separation of the upper epiphysis or fracture through the tuberosities or neck of the bone, the upper end of the diaphysis or the lower fragment of the broken bone is drawn inward and forward by the pectoral muscles, the case may simulate that of dislocation. The mistake, however, should not be made, as in the early period of the accident increased mobility of the bone and crepitus should be enough to indicate its nature; and, in the later period when the deformity produced by the end of the lower fragment is visible, the accident is palpable.

When impacted.

When in fracture impaction of either fragment exists, no crepitus will be felt unless forcible movement be made, when it may be elicited. Care, however, should be observed in seeking for this information, as a forcible separation of the impacted bones is a fatal error. The accident is generally to be made out by the nature of the injury, the shortening of the limb, the absence of crepitus, and the movement of the head of the bone on making gentle rotation of the shaft.

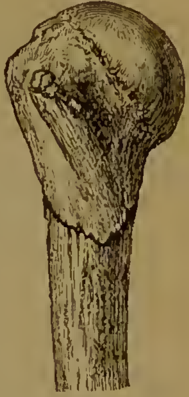
Treatment.

In fractures of the *anatomical neck* when the head of the bone is driven into the tuberosity and shaft, as in all other forms of impacted fracture, union will go on if the impacted bones are not displaced by manipulation. The Surgeon, therefore, has only to apply some simple splint, such as an anterior and posterior or lateral, or Stromeyer's cushion (Fig. 497), to maintain rest. The same treatment is applicable in fracture or separation of the epiphyses when the bones have been replaced. In the case illustrated in Fig. 483, a capital arm existed.

Of surgical neck.

Fracture of the surgical *neck of the humerus* below the tuberosities, is, however, probably the most common form of accident, and the line of fracture may be transverse or oblique (Fig. 484). In it, when the bone is broken above the insertion of the pectoral muscle—its usual seat —the lower fragment is drawn *inwards* towards the chest, whilst the upper fragment is drawn upwards and *outwards* by the muscles that are inserted into the tuberosities. The bone projects forward or backward according to the direction of the fracture, the direction depending greatly upon that of the force. The more oblique the line of fracture, the greater the deformity. Impaction of the broken fragments may occur in this as in the last fracture, the lower usually penetrating the upper.

FIG. 484.



Fracture of the surgical neck of the humerus. Prep. 1107^{37}.

Treatment.

TREATMENT.—The nature of the accident having been ascertained and the question of impaction or non-impaction decided, the treatment becomes simple, for in the *impacted* fracture whether of the anatomical or surgical neck, the aim should be to keep the impacted bones in position and to prevent their being loosened so that natural processes may effect a cure in a month or six weeks with a limited degree of deformity; and in a *non-impacted* fracture, the first aim is to bring the bones into as good apposition as possible, and to keep them there by means of splints and position. In doing this the tendency of the fracture has to be considered, which is, that the lower fragment is drawn inwards by the pectoral muscle, and the upper fragment outwards by the scapular muscles. The best plan to carry out these objects is to fix the arm between an inside right angular and outside straight splint, the former extending from the axilla to the wrist, and the latter to the elbow, the two being bound well together. It is a dangerous practice simply to place the forearm in a sling and bind the arm to the side. When much injury to the soft parts or any wound exists, it is an excellent plan to draw the arm outward from the body at half a right angle and to rest it on the splint with the forearm partially flexed, care being taken that the lower fragment is not drawn too far inward, or to bind it on Stromeyer's cushion.

At other times, a good gutta-percha, felt, or leather casing, moulded to the shoulder and arm, is very efficient, or a bent leather splint, the angle being well pressed into the axilla, with one half fixed to the arm, and the other to the thorax.

In all these cases the Surgeon should explain to the patient that some impairment of the mobility of the limb may be expected, and some shortening in impacted fractures.

Of the greater tuberosity.

Symptoms.

Fractures of the greater tuberosity is a recognised accident, and is usually associated with dislocation of the humerus forwards, the scapular muscles drawing the tuberosity backwards. Dr. R. Smith, in his excellent work on Fractures, gives a description of two of these cases. He describes a remarkable increase in the breadth of the articulation, the projection of the acromion and flattening of the deltoid, as the most striking features of the injury. He also draws attention to the *vertical sulcus* corresponding to the bicipital groove, formed by the head of the bone on the inner side and the displaced tuberosity on the outer, as one of the characteristic symptoms.

Of the shaft.

Shortening.

Fractures of the shaft of the humerus are common, and more readily made out as well as successfully treated than any other fracture. When oblique, they are frequently followed by some degree of shortening, but this result is of little practical importance, as it interferes but slightly with the functions of the hand. Such fractures are as commonly the result of direct as of indirect violence, muscular action being by no means an uncommon cause. I have already mentioned an instance in which it occurred in a man during a marital embrace, and a second produced by throwing a ball. Lonsdale, Malgaigne, Hamilton, and others have recorded similar instances.

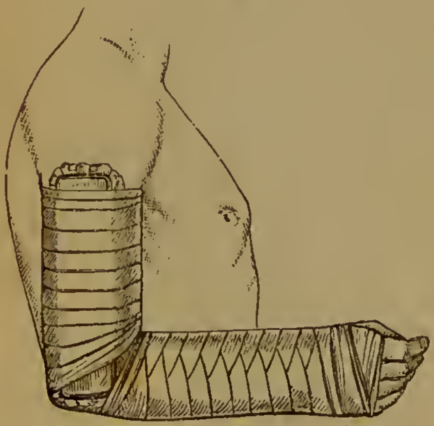
Displacement.

When the fracture is transverse, there is no displacement. When oblique, the tendency of the lower fragment to ride will depend upon the line of the obliquity and its position. When the line of fracture is below the insertion of the deltoid, the upper fragment will have a tendency to be drawn outwards; when above this point, the upper fragment will be attracted inwards by the pectoral muscles, the lower fragment being drawn upwards and outwards by the deltoid.

Symptoms.

Loss of power in the arm, mobility of the bone, crepitus, local pain, and deformity are ample symptoms to indicate the accident. An error in diagnosis ought not to occur.

FIG. 485.



Splint for fracture at the shaft of the humerus.

Treatment.

Boyer's rule.

TREATMENT.—This is not really difficult, although from the fact that ununited fracture is more frequently found in this bone than in any other, it would appear as if the practice were less successful. Agnew states that out of 685 cases of non-union of bone, 219, or about 32 per cent., were of the humerus. I would explain the fact by the want of a due appreciation of Boyer's rule of treatment, viz. to keep the joints above and below the broken bone in absolute rest; for in fractures of the arm the common practice of applying splints to it, and allowing perfect freedom to the action of the forearm, is to be condemned; because in moving the forearm the triceps and brachialis anticus, with the biceps, have as powerful an action upon the humerus as upon the bones of the forearm.

In the primary treatment of all fractures of the arm it is a wise and scientific practice to keep the forearm at rest, which is best done by the application of some angular splint extending from the shoulder or axilla to the wrist, associating with it a posterior or anterior short splint, reaching from the shoulder to the elbow (Fig. 485). After about two or three weeks the angular splint may be removed, and some immovable one applied, the forearm being left free.

Any splints that secure immobility of the broken bone after its ends have been co-apted by manipulation must be regarded as beneficial, and no splints can do this effectually that allows freedom of movement of the forearm. When two lateral splints appear the more adapted to keep the bones in position they must be angular, to include the elbow, and bent at a right angle.

The incomplete or green-stick fractures of children are well treated by millboard, gutta percha, or felt splint, after the bone has been restored to its normal position.

In putting up fractures of the arm, care should be observed not to press upon the musculo-spiral nerve as it winds round the bone, especially when the line of fracture corresponds to its position.

Fractures of the lower end.

Fractures involving the lower end of the humerus, whether transverse above or vertical through the condyles, or both together; whether complicated with separation of the epiphysis or some displacement of the bones of the forearm, are always difficult to diagnose and to treat; and when the joint is involved, either by the fracture running into it or by displacement, there is usually some subsequent imperfection in its movement.

Symptoms.

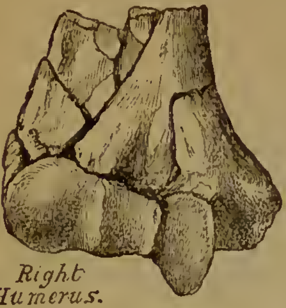
Fractures above the condyles, where the bone is thin and expanded, whether in the child or adult, or separation of the lower epiphysis (an accident of early life) are usually produced by some fall upon the elbow. When the line of fracture is oblique from behind forwards the action of the biceps and brachialis anticus has a tendency to draw the forearm with the lower fragment upward and forward. When the line of fracture is oblique from before backwards and upwards, the lower fragment of bone with the bones of the forearm is apt to be drawn backward by the action of the triceps, thereby giving rise to the external appearance of a dislocation of the bones of the forearm backwards, since there is the same projection of the olecranon process and hollowness above it, the same projection of the lower end of the humerus forwards, with the pressing forwards of the artery in both accidents. There is, however, this great distinction between the fracture and dislocation, so well expressed by Sir A. Cooper. In fracture there is, he says, "the removal of all marks of dislocation on extension, and their return as soon as extension is discontinued;" crepitus of a marked kind is felt where a fracture is present, and of a suppressed kind where a displacement of the epiphysis exists; whereas in dislocation no crepitus is present, and there is marked immobility of the bones, the bones of the forearm and the condyles of the humerus having lost their natural relative position. Malgaigne also pointed out, that in fracture there will be a shortening between the acromion process and the internal condyle, whereas in dislocation there will be none. In fracture, the anterior projection of the end of the humerus is *above* the fold of the elbow, and not so broad or round as in dislocation, where it is *below* it.

Fracture of the condyles into the joint.

Symptoms.

Fracture of the condyles into the joint is a grave accident, and likely to be followed by some stiffness of the joint. It may be oblique in any direction, the outer or the inner condyle being fractured, or associated with a transverse fracture of the bone (Fig. 486). The existence of the fracture can be made out by manipulation, the amount of displacement varying with the character of the injury. Crepitus can also be detected by grasping one or other condyle and moving the broken fragment, while rotation of the radius often gives rise to it when the external condyle is involved. Flexing the ulna also produces it when the internal condyle is affected.

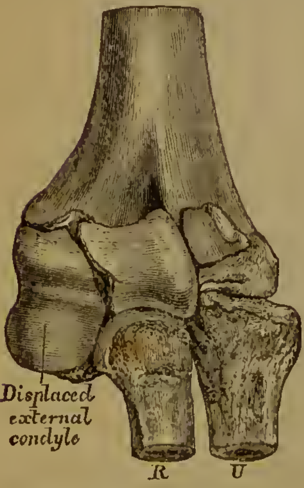
Fig. 486.



Comminuted fracture of the condyles of the humerus. Prep. 1112^{75}.

All these fractures into the elbow-joint are rapidly followed by effusion, which often masks the symptoms, and renders the diagnosis difficult and uncertain. Under these circumstances no diagnosis should be attempted until, by rest and cold applications, the effusion has been absorbed, and a full examination can be satisfactorily made. A few days are usually enough for this change to take place. In rare cases the inner condyle is simply chipped off, the joint not being implicated. I have recently had a case of the kind in a woman, in which the ulnar nerve was injured.

Fig. 486a



Displaced and comminuted fracture of the lower epiphysis of the humerus, with dislocation of the radius and ulna inwards.

Treatment.

Treatment.—In all these cases of fractures involving the condyles of the humerus, whether into the joint or not, the fragments should be brought into position by extension upon the forearm when needed, with manipulation, and an anterior jointed rectangular splint applied, the upper half of the splint being well passed up the arm, and the lower to the wrist. In some cases a posterior arm splint, projecting down to the olecranon process, is of use, the whole being well bound together and to the limb. The joint, as a rule, may be left exposed for external applications. Some Surgeons prefer from the first an immovable casing of gutta percha or felt, while others, like lateral leather or pasteboard splints, but I think it preferable to leave the joint exposed.

Period of union.

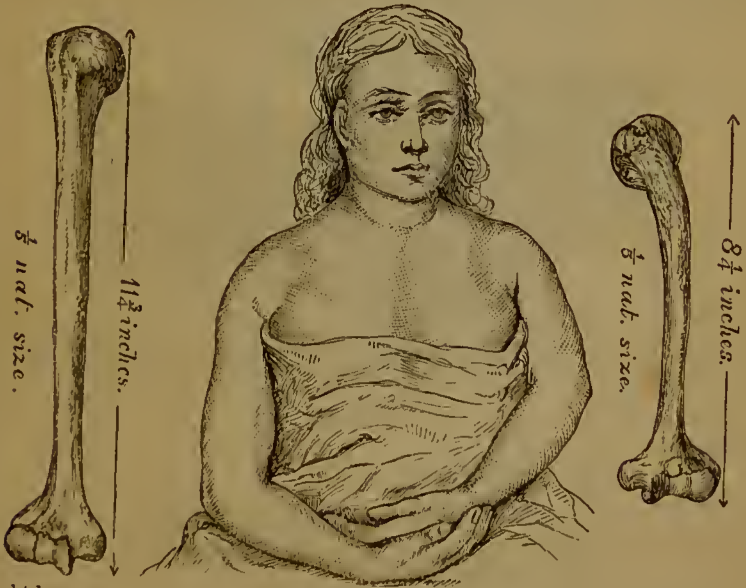
In children the bones unite in about three weeks, and in adults after a month; consequently all splints should be removed at the end of these periods, and passive movement allowed. Hamilton, however, in his great work on Fractures, states his belief that passive movement ought to be commenced within seven days, and perseveringly employed until the cure is accomplished. He does not admit the use of splints after this period, believing that the new material has steadied the fragments, and that the danger of displacement is but little, while the prevention of anchylosis demands early and continued motion.

Fracture and dislocation.

Fractures of one or other of the condyles of the humerus, complicated with dislocation of the bones of the forearm, occasionally occur, and when they do they are difficult to diagnose, and more difficult to treat. In the following case the cause of the difficulty of reduction was explained by the fact that the external articular facet of the humerus had been vertically displaced, and the head of the radius was in contact with the inner articular facet, whilst the ulna worked upon the internal condyle. The case was that of a boy, æt. 10, who fell upon his hand, with his arm extended, from a horse's back, the force having been carried through the radius to the outer condyle. The injury was regarded at the time as one of T-fracture of the humerus. When I saw the boy, six weeks after the accident, the injury seemed to be one of dislocation of the bones of the forearm inwards, with great thickening of the external condyle. The arm was much extended. As reduction was impossible, resection was carried out with a good result.

The preparation and drawing (Fig. 486A) show that the external condyle had been broken and vertically displaced. The head of the radius and ulna were both displaced inwards, and well locked by processes of bone, explaining very clearly the difficulty in reduction.

FIG. 487.



Right humerus. Arrest of growth in the humerus after fracture in early life. Left humerus.

The coronoid process of the ulna was in contact with the outer portion of the internal condyle, and its outer edge with the inner margin of the trochlear surface of the humerus.

The head of the radius rotated on the displaced inner half of the articular facet of the humerus, with its outer edge in contact with the displaced external condyle. The olecranon fossa was partially filled up.

Arrest of growth after fracture.

After fracture of the humerus, as of other bones, arrest of growth may follow. I have seen such an arrest of growth in the humerus of a woman, to the extent of three and a half inches, after a fracture of the shaft which occurred when she was about eight years of age (Fig. 487). I have also recorded ('Guy's Hosp. Rep.,' 1862) a case of a woman, æt. 30, in which with a stiff shoulder-joint, the humerus was five inches shorter than its fellow, the shortening having followed some injury to the upper part of the bone during infancy. In the first case, the arrest of growth was probably due to some injury to the nutrient artery of the bone, in the second, to injury to the epiphysial cartilage at the upper part of the shaft.

Fractures of the Bones of the Forearm.

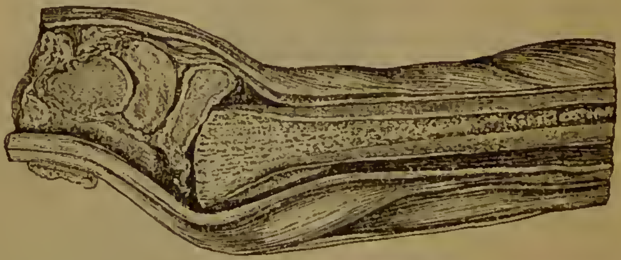
Fractures of the forearm.

These form about two fifths of all fractures, half the cases consisting of fracture of the radius alone, a fourth of fracture of the ulna including the olecranon process, and the remaining fourth of the two bones together; fracture of the radius and ulna together being about equal in frequency to that of the clavicle.

Of the radius.

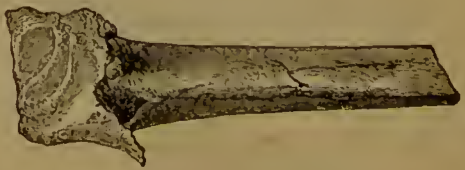
Fracture of the radius may take place at its head, neck, shaft, or lower end. When of the neck or shaft, and transverse, the fragments of bone are usually loose, yielding on manipulation a distinct crepitus, the head of the bone being felt not to rotate in its position; but, when

Fig. 488.



Vertical section of radius, epiphysis, and soft parts, showing separation and backward displacement of the lower epiphysis of the radius. Taken from a boy, æt. 10.

Fig. 488a.



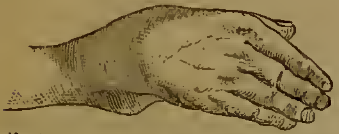
Fracture and backward rotation of the lower end of the radius, with impaction of the upper fragment. From a patient of Mr. Lucas.

the head of the bone is fissured longitudinally no such symptoms will be present.

In a case of injury to the right upper extremity in a man, æt. 30, complicated with brain mischief, which came under my care in 1877, there was an impacted Colles's fracture of the right radius and a vertical fracture of the head of the same bone into the joint. He had evidently fallen from a height upon his right hand and head.

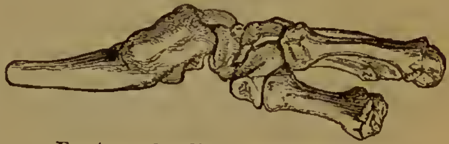
Fractures of the *lower end* of the bone are of a very variable nature. They are as a rule caused by a fall upon the outspread hand with forcible extension backwards; but they may be due to a fall upon the back of the hand with the wrist flexed. Many of them are impacted, the compact shaft of the bone being driven into the cancellated carpal extremity; and when impaction does not exist, it is frequently from comminution of the lower fragment. In possibly half of the cases of Colles's fracture, however, there is no impaction, the end of the radius being fractured and rotated backwards. In young people a separation of the epiphysis backwards may occur (Fig. 488).

FIG. 489.



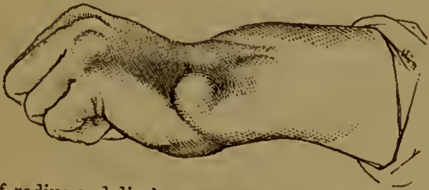
Colles's fracture of lower end of radius and displacement backwards. Dorsal view. From Dr. R. W. Smith.

FIG. 489A.



Fracture of radius and displacement backwards. Side view. From Dr. R. W. Smith.

FIG. 490.



Fracture of radius and displacement forwards. From R. W. Smith.

Colles's fracture.

Fractures of the lower end have always been of special interest. Colles, of Dublin, first described them in 1814 ('Edin. Med. and Surg. Journal'), and such injuries are now generally known as Colles's fracture. Dr. R. W. Smith has done much to draw attention to their nature in his work on fracture, where he explains the characteristic deformity by muscular action. Figs. 489-9A show the appearance of the wrist; with displacement of the broken end and hand backwards; Fig. 490 shows fracture with displacement forwards.

Callender on deformity in Colles's fracture.

Callender in an able paper ('St. Barth. Rep.,' 1865), showed that Voillemier, Malgaigne, and Nélaton's views are often correct, and that *impaction* rather than muscular action is the true explanation of the deformity.

"The radius is first broken, then, by the momentary continuance of the force in the direction of the falling body, forwards and outwards, the shaft is driven into the carpal end, burying itself chiefly from the dorsal surface towards the palm, and towards the outer or the inner side. In a great number of cases this impaction so fixes the fragments that they cannot be unlocked, and the deformity is permanent."—*Callender.* The thirty-six specimens of fracture of the lower end of the radius which the museums connected with the London schools of medicine contain, clearly manifest that the cause of each deformity is the impaction of the proximal in the distal portion of the broken bone.

Gordon, however, has demonstrated from twenty-seven specimens in the Belfast Museum that impaction is not constant. In nineteen of his examples there was oblique fracture of the bone from before backwards and upwards, and in eight the fracture was transverse. He believes Colles's fracture is "caused by the fall upon the palm of the hand, the fall forcing the hand backwards, putting the anterior carpal ligaments and flexor tendons violently on the stretch, wrenching off by the 'cross-breaking strain' the lower end of the radius, tilting it backwards, with alteration of the aspect of its carpal surface, and the bearing of the carpus upon it, leaving a gap between the fragments in front." He likewise thinks that fractures produced by a fall on the back of the hand with the wrist flexed are often impacted.

Seat.

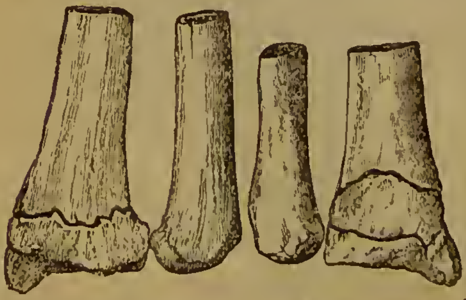
The fracture is usually placed about half an inch or an inch above the wrist-joint, and the lower fragment or epiphysis is displaced backwards. It is, moreover, so displaced that the articular facet instead of looking downwards, forwards, and inwards is made by rotation to look downwards, backwards, and outwards. The outer side of the fracture towards the styloid process is rotated more than the inner, the strong ligaments uniting this with the ulna holding the bone more in position. On this account the lower fragment is often also broken vertically, giving rise to greater deformity as well as to shortening of the bone on its outer border. In rare examples the fracture of the radius is complicated with dislocation of the scaphoid bone, forwards. Dr. Cameron ('Glas. Journ,' March, 1875), of Glasgow, and Mr. Knott (Surg. Soc., of Ireland, Jan., 1881), of Dublin, both give examples of this. In some cases, the end of the bone is comminuted (Guy's Museum, 1119[32]), and Fig. 491 illustrates a case of fracture of both radii from a fall on the hands.

Dislocation of scaphoid bone.

Diagnosis.

The *diagnosis* of this accident is not difficult; indeed, the aspect of the wrist may be said to be characteristic. "The posterior surface of the limb," wrote Colles, "presents a considerable deformity; for a depression is seen in the forearm, about an inch and a half above the end of the bone, whilst a considerable swelling occupies the wrist and metacarpus; indeed the carpus and base of the metacarpus appear to be thrown backwards so much, as, on first view, to excite a suspicion that the radius has been dislocated forwards. On viewing the anterior surface of the

Fig. 491.



Fractured end of radius; and styloid process of the ulna. Prep. 1118[20].

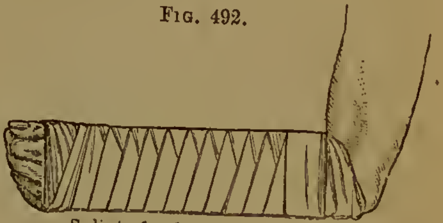
limb we observe a considerable fulness as if caused by the flexor tendons being thrown forwards; this fulness extends upwards to about one third of the length of the forearm, and terminates below at the upper edge of the annular ligament of the wrist. The extremity of the ulna is seen projecting towards the palm and inner edge of the limb" (*vide* Fig. 488). The amount of deformity turns upon the amount of displacement of the broken fragments. There will be pain in the part, increased by pressure on the seat of fracture and about the internal lateral ligament; the movement of the joint being rendered impossible. On feeble movement of the hand, the head of the radius will be felt to rotate when the fracture is an impacted one; crepitus will either be absent or very indistinct, and can only be well brought out by loosening the broken bones. In rare cases these fractures are compound, the end of the shaft of the radius projecting forwards. More commonly, however, the ulna is made to protrude; both these conditions existed in the case from which Fig. 496 was taken.

Treatment.

TREATMENT.—In all fractures of the radius, it is essential to keep the hand at rest, and, as a consequence, all splints should extend at any rate down to the base of the fingers. In fractures of the neck or shaft, the elbow should be bent at right angles and the hand held midway between pronation and supination; two well-padded broad splints extending down to the fingers being firmly fixed on by strapping, broad bands, or a roller (Fig. 492). When, as in fractures of the shaft, there is a disposition for the fragments to fall inward, some extra pad may be employed.

Of neck and shaft.

FIG. 492.



Splints for fracture of forearm.

The splints should be removed after three weeks, and freedom given to the hand, movement of the muscles being encouraged; shorter splints or some immovable apparatus should also be substituted down to the wrist whilst union is being consolidated. Lateral pressure of the bandages must always be avoided.

Lower end.

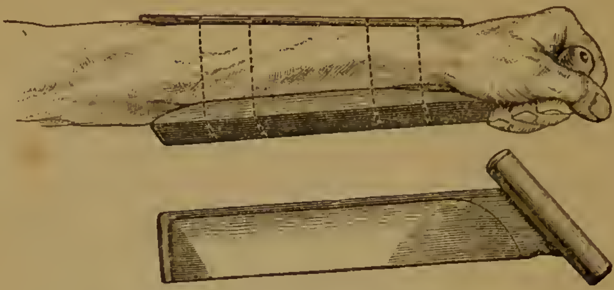
Pistol splint condemned.

In fractures of the lower extremity of the radius the old-fashioned pistol-shaped splint is still in favour with some, its object being to keep the hand and wrist adducted, and thereby to counteract the deformity that so commonly attends this form of fracture. Some Surgeons, and more particularly the American, apply it to the palmar, and others, including Nélaton, to the dorsal aspect, with a shorter second splint. I am no believer in its virtues, for if the fracture be impacted, and the fragments are not loosened, it is useless, as union has only to go on between the impacted fragments for a cure to be effected; and when the fragments are loosened and the bones brought into apposition by extension and manipulation, the pistol splint is not wanted, indeed, it is probably injurious, causing displacement of the broken bones. A well-padded broad anterior splint, reaching to the roots of the fingers, with a dorsal splint, answers every purpose, the wants of the individual case determining the amount and position of the extra padding. The best splint is without doubt that known as Carr's splint (Fig. 492A). They are about 11½ inches long and two inches wide. The anterior one

Carr's splint.

has an irregular convex surface to fit into the concavity of the lower side of the radius, and the posterior is flat; connected with the anterior an oblique cross-bar four inches long is fixed for the patient to grasp. When padded and nicely fixed with strapping or a bandage, it is efficient and comfortable.

FIG. 492A.

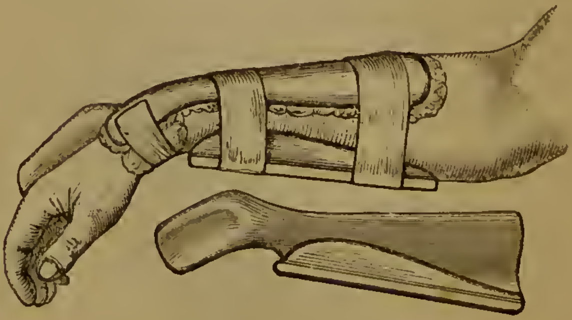


Carr's splint.

Gordon's splint.

Dr. Gordon, of Belfast, has introduced a splint that has found favour. It "consists of the body, the ulnar and bevelled portions, with a curved back splint. (Fig. 493). The lower end of the ulnar portion is curved forwards and hollowed to receive the inner border of the flexed hand, with a slit for the carpal strap. The bevelled portion is secured to the body of the splint nearly half an inch internal to its margin; it is cut off obliquely from without inwards and from below upwards; it is applied to the palmar surface of the upper fragment, which it is its office to fix. The lower end of the back splint is much curved forwards. This curve, with a thick pad, is necessary to enable it to press the base of the metacarpus, the carpus, and the lower end of the lower fragment *well forwards* for the restoration of the natural aspect of the carpal surface and the concavity of the radius" (p. 24, 'Gordon on Fractures of Radius,' &c., 1875).

FIG. 493.



Dr. Gordon's splint for Colles's fracture.

The forearm should be well supported by a sling.

After this form of fracture, the wrist-joint rarely recovers its normal movement, some deformity permanently remaining, and of this the patient ought to be warned. I have recently, however, had under care (June, 1878) a case of double compound Colles's fracture, in which a recovery took place without any deformity.

Of the ulna.

Fractures of the ulna are almost always the result of direct violence, the middle and lower parts of the shaft—the thinner portions—usually suffering. In these cases, there is, as a rule, little displacement, and when it exists it is of the lower fragment. On manipulation, crepitus is usually present with local pain. Fracture of the *olecranon* process is a very frequent accident from a fall or blow upon the elbow, or a sudden action of the triceps. In it, there is always more or less displacement of the end of the process, and the smaller the piece the greater the displacement, the base of the process being held well in position by the fascia covering the bone and the periosteum. Fracture of the *coronoid* process (Guy's Museum, 1119^{25}), with or without dislocation of the ulna backwards, has also been described; though very rare. In the case from which Fig. 495 was taken, it co-existed with fracture of the head of the radius. The styloid process of the ulna may likewise be broken and displaced forwards or backwards, and is generally caused by a fall upon the hand; it is, consequently, a frequent accompaniment of Colles's fracture.

Symptoms of fractured shaft.

Of olecranon

TREATMENT.—In fractures of the shaft the treatment is simple, the radius acting as a splint and preventing shortening. The Surgeon has only to see that the broken bone is kept quiet, and that the fragments are in position. This is well done by means of well-padded anterior and posterior splints, the hands being fixed in a position mid-way between pronation and supination, Carr's splint being the best.

In fractures of the *coronoid* process, the forearm should be kept flexed to relax the brachialis anticus muscle which is inserted into it; and in fractures of the *olecranon*, nearly *straight*, to relax the triceps, through which the separation of the fragments takes place. The splint may be strapped on or fixed by strapping, and, in severe cases, an immovable apparatus is advisable.

Some separation of the fragments very frequently remain after fracture of the olecranon, which increases when the arm is used too soon, the power of the arm being consequently weakened. Passive movement of the arm, however, should always be permitted about five weeks after the accident, all violent efforts being condemned.

Of both bones.

Cause.

Fracture of both radius and ulna occurs about as frequently as fracture of the ulna alone, but not a quarter so often as fracture of the radius. *Direct* violence is the usual cause, a fall upon the hand being more commonly followed by fracture of the radius than of the two bones.

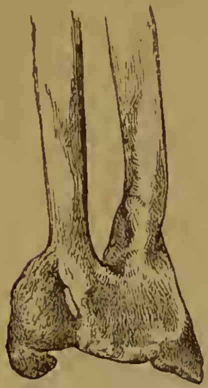
Malgaigne has recorded instances of this accident from muscular action. In infants, the "*green-stick*" or "*incomplete*" fracture of both bones is not infrequent.

The fracture may be transverse, oblique, or comminuted, and the displacement of the fragment may vary vastly according to the direction and violence of the force which produced it.

These fractures are readily made out, and not often difficult to manage, although at times the Surgeon's ingenuity is taxed to prevent deformity.

Treatment.

FIG. 494.



Radius and ulna consolidated after fracture. Prep. 1119^{30}.

Under all circumstances, the forearm should be flexed, and the hand kept in the semi-prone position. Two *wide* splints should be employed, well-padded, broad, and coming down to the roots of the fingers, the Surgeon so arranging his pads as to prevent deformity and to neutralise the peculiar tendency of the fracture. When the parts are bandaged too tightly, the bones may be pressed together and consolidation takes place as a whole, with consequent loss of motion, or the two bones may be braced together by some bony isthmus (Fig. 494). *Under all circumstances, the fracture should be put up with the hand supinated,* the dorsal splint being first applied and then the palmar, the forearm being semi-flexed. When fracture of the radius and ulna takes place above the wrist-joint, the symptoms may simulate those of dislocation; but the greater mobility of the lower ends of the bones, crepitus, and local pain, ought to forbid the error being acted upon.

Of carpal.

Fracture of the carpal bones can only occur from direct violence, some crushing force being the usual form. It may be difficult to diagnose, as the same force that produced the fracture to a certainty will have injured the soft parts around the bones. Happily, however, the treatment of any severe injury to the wrist should be such as will serve for all; for the application of an anterior splint, as well as cold lotions and absolute rest of the injured part, ought always to be observed in all clear as in doubtful cases, and with these a good result may generally be secured.

Of metacarpus.

Fracture of the metacarpal bones is not rare. It is commonly caused by some blow when fighting or other form of direct violence. Thus it is most frequent in the right first and fifth bones. Dr. E. H. Bennett, of Dublin, has shown ('Dub. Journ. of Med. Sci.,' Jan., 1882) that in the commonest form the fracture passes obliquely through the base of the bone, detaching the greater part of the articular facet, and allowing the body of the bone to be displaced with the thumb backwards. It is rarely complicated with much displacement. In young subjects, the head of the bone or epiphysis may be displaced. It should be treated as all fractures, "with brains," the pads and splints being so applied as to fulfil the wants of the individual case. In the majority, a simple pad placed on the palm with an anterior splint may be sufficient. In one case, Malgaigue's plan of placing a thick compress under the head of the bone, and a second over the dorsal projection with two broad splints across the hand may be called for. In another, Sir A. Cooper's, of binding the flexed fingers over a ball, may fulfil the necessary requirements; but, as a rule, an anterior splint and palmar pad carefully adjusted, supplies every want and is sufficient, the Surgeon remembering that the palmar surfaces of these metacarpal as well as phalangeal bones are concave.

Of phalanges.

Fracture of the phalanges is usually compound, although it may be simple, and is easily diagnosed and readily treated. A simple anterior splint is all that is required, a dorsal being rarely called for; a piece of wood serving for the purpose, though a thin piece of perforated zinc is preferable. The splint should be fixed on with strapping, a coating of the compound tincture of benzoin rendering all firm and immovable.

Compound fracture into elbow-joint.

In compound fracture into the elbow-joint when the parts are much injured, excision, probably, is the wisest step to adopt, as by it convalescence is hastened and a good arm with a movable joint as a rule, given; whereas a recovery by natural processes without operation, will probably end with anchylosis after a tedious process of suppuration. When the injury, however, is not severe and the patient young, excision is not called for, a recovery with a movable joint being possible. I have had several excellent examples of this under my care during the last few years. In aged subjects, however, amputation may be required; and in the one from which the preparation (Fig. 495) was taken, such a step was demanded. The drawing illustrates an uncommon form of accident—comminuted fracture of the head of the radius and fracture of the coronoid process.

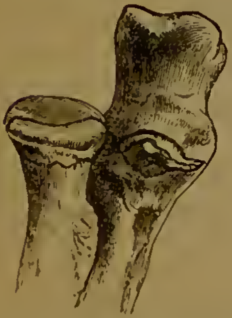
Compound fracture of arm and forearm.

Compound fractures of the arm and forearm ought to be treated upon the same principles as the simple, that is, when the injury is not sufficient to necessitate amputation or excision, the bones should be brought into apposition and kept there by means of splints interrupted or not, the wounds being covered either by lint soaked in blood or, by what is better, the compound tincture of benzoin. It may be added, that the injury should indeed be great to necessitate amputation, it being justifiable to incur some extra risk to save the hand.

Case.

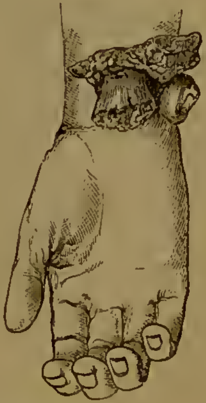
In a severe case of compound comminuted fracture of the humerus caused by the passage of a rifle bullet through the bone in a young man, which came under my care at Guy's, good success attended the immediate sealing of the wound with benzoin, and the application of the splint. The man left the hospital in three months with a firmly united bone and a good sound arm. In such a case as that

FIG. 495.



Fracture of the coronoid process and head of radius, produced by a fall upon the elbow; taken from a woman, æt. 70.

FIG. 496.



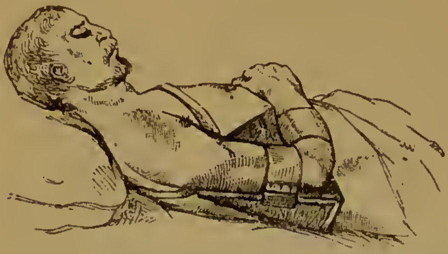
Compound dislocation of ulna and shaft of radius forwards with displacement of the lower epiphysis of the radius backwards.

represented in Fig. 496, where displacement of the lower epiphysis of the radius and dislocation of the ulna existed, amputation was demanded.

Stromeyer's cushion.

I have little to add to what has already been given in the way of treatment of compound fracture of the humerus beyond an allusion to Stromeyer's cushion, which commends itself to attention as much by the eminence of its advocate as by its usefulness. It was introduced to our notice by Sir William MacCormac (Fig. 497).

FIG. 497.



Stromeyer's cushion (from MacCormac). With straps applied.

The cushion may be described as triangular and wedge-shaped. At its thickest end it measures four inches in depth, and from this point gradually thins down for a length of fourteen or fifteen inches. The elbow rests on the thick end, while the thin rests on the side of the chest. The cushion is readily fastened in its place by a tape round the neck and the body; and when this simple apparatus is applied, the arm rests beautifully supported and in excellent position. Whilst lying in bed nothing beyond the ordinary dressings are required for the wound, and, if the patient has to be transported from one place to another, or is fit to walk about, this can be arranged with the utmost facility, as cushion, arm, and all can be bound by a broad bandage to the body and thus form an immovable whole. Stromeyer considered this cushion to be "the most valuable appliance he had invented during his life." I have used it for fracture and dislocation of the humerus and shoulder-joint disease, with great advantage, and have adapted straps to it to hold the arm and forearm in position.

Compound dislocation with fracture of phalanges.

Compound dislocation and fracture of the phalangeal joints require a distinct consideration, and the slight constitutional symptoms which such injuries induce, enable the Surgeon to treat them on purely local considerations.

To dwell on the importance of the integrity of the hand as a whole, or to adduce arguments to show the necessity of saving as much as possible of the thumb and fingers is unnecessary, since these rules of practice are now acknowledged; yet such have their limit, as anchylosis of some of these joints may prove an impediment rather than an advantage to the free use of the hand, and a stiff finger to a man in one business may be most detrimental, while in another, if bent it may be of service.

Thumb to be preserved at all hazards.

With the thumb, however, the above rule may be considered absolute, and an attempt should invariably be made to save the joints and as much as possible of the injured parts; it being often better in compound fractures to leave the bone to granulate than to remove it, for the use which may be made of the stump of a thumb, or of one fixed by anchylosis, can only be appreciated by those who have been fortunate enough to witness such instances.

With the fingers, this rule will not hold so good, since it often happens that the loss of a finger will be found of less inconvenience than a stiff one. In a general point of view, a stiff metacarpo-phalangeal joint to a labouring man is an impediment, while to a gentleman it may be of service, and at the same time preserve the comeliness of the part. A stiff first phalangeal joint will be most prejudicial in some trades, while in others it is of slight importance. A stiff joint between the extreme phalanges is rarely of much moment.

Care required in determining the angle at which anchylosis shall take place.

The patient, however, should be consulted by the Surgeon in all these cases, and the treatment adapted to the wants of the individual; since a position that may be good for one may be bad for another, and no one position is applicable to all. It is too common to find men applying at London hospitals to have fingers removed that have been saved, but fixed at bad angles; the stiff finger being an impediment to the free performance of their trade.

In compound fractures and dislocations of the thumb, loose fragments of bone should be removed and joints excised; as much as possible of the soft parts should be saved, and the wound left to natural processes for repair. To amputate a thumb for injury ought to be a very rare operation. In these injuries to the fingers the same principles of practice should be adopted, although modified by the wants of the individual case. To save a finger, and to amputate it months after on account of some stiffness of joint or malposition is to waste time. When a joint has been opened, and anchylosis must be looked for after a natural recovery, the propriety of making the attempt should be discussed before the practice is decided upon, when, if the decision be in favour of a conservative practice, the injured parts should be adjusted and fixed by means of a splint in the most favorable position.

Compound fracture of the thumb.

Of the fingers.

In most subjects, the straight is a forced and inconvenient position, and not that ever assumed by nature, with the hand at rest. The best is the slightly bent, when the thumb and fingers can touch at their tips, or that which the hand naturally assumes when at rest. In exceptional cases, however, exceptional positions may be required. I have for years acted upon this principle, and always with advantage.

Straight position not often the best.

The best splint for fingers is a piece of perforated zinc. It is thin, and can be bent to the required curve without trouble as well as readily fixed on with strapping or lint saturated in tincture of benzoin.

Zinc splint.

FRACTURES OF THE LOWER EXTREMITY.

Fractures of the pelvis as of the cranium, spine, and thorax, are of importance, inasmuch as the visceral contents are involved, but when no such complications exist, the injury is, comparatively, not dangerous.

Fractures of pelvis.

Fracture and dislocation of the bones commonly occur together, and may be regarded as alike in a clinical point of view.

The anterior portion of the crest of the ilium is not rarely broken from direct violence, and the accident is not serious. Rest in bed to keep the abdominal muscles quiet, and the application of a pad with strapping, a mould of gutta percha, or a broad pelvic belt when displacement exists, are the ordinary surgical means required.

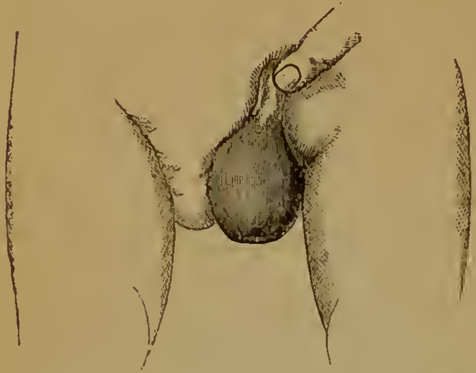
Of crest.

Of pelvic basin.

Examples.

Fracture of the pelvic basin itself is usually the result of some crushing force, the weakest part breaking, such as the rami of the pubes. In other cases, there will be some separation of the pubic bones at the symphysis or other fracture of the brim. In many, the injury will be complicated with laceration of the urethra. In the case of a female, æt. 30, which I had under care, the bones were displaced on the right side for more than an inch, when a curious deformity resulted; the pelvic bones with the adductor muscles being curved out, leaving a hollow on the inner side of the thigh.

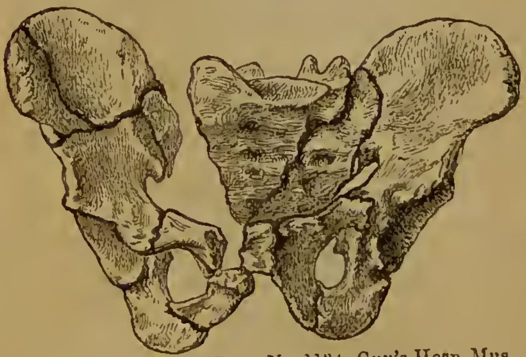
Fig. 498.



Fracture of the pelvis in a child, with separation of pubes, prolapse of rectum and uterus.

In another, sent to me by Dr. Bennett, of Builth, in a female child, great separation of the pelvic bones was present, the whole pelvic organs having been pressed out of the outlet of the pelvis by the crushing force. The large intestine for about a foot, uterus, bladder, &c., were all in view, the whole perinæum having been ruptured. The drawing (Fig. 498) shows the child's condition when I saw her fourteen months after the accident. How the child escaped with life was a mystery, the perinæum being gone, the bowels protruding, and the bones of the pelvis widely apart. Such a case is enough to show how great an injury the pelvis may occasionally sustain without causing death. As an example of fractured pelvis, Fig. 499 may be referred to.

Fig. 499.



Fracture of pelvis. Prep. No. 1134, Guy's Hosp. Mus.

Urethral complication.

Case.

Diagnosis. — The greatest care is necessary in examining the subject of a suspected fracture of the pelvis, yet the diagnosis can generally be made from the nature of the force employed, its direction, and the complications that exist. Urethral complication is the most common in the male, and ought to be treated as already described at p. 165, Vol. II. As an illustration of the practice there recommended, in June, 1875, a boy, æt. 7, was admitted under my care into Guy's Hospital, with fracture of the pubic bones and laceration of the urethra, accompanied with profuse hæmorrhage and retention, for which catheterism was ineffectual, and death seemed imminent. I consequently made a free incision into the perinæum down to the lacerated urethra upon a grooved staff, and a rapid recovery took place after. Under all circumstances, the utmost quiet must be enforced, for if the Surgeon is unable to restore the fractured bones to their normal position, at any rate, he must do nothing to render their displacement greater, or increase the risk of visceral injury. Where support by means of a bandage, strapping, or casing of gutta percha or some other substance gives comfort or seems called for, it should be applied; but, in general, absolute rest, and such treatment as the complication may require, are all that is necessary. In two cases, I have seen obstruction of the iliac artery associated with fracture of the brim of the pelvis; in one, the vessel was so stretched as to cause laceration of its inner and middle coats and obstruction, which were followed by gangrene of the corresponding limb. In the other the obstruction lasted three weeks, when pulsation returned and the patient recovered.

Obstruction of iliac artery.

Fracture of acetabulum.

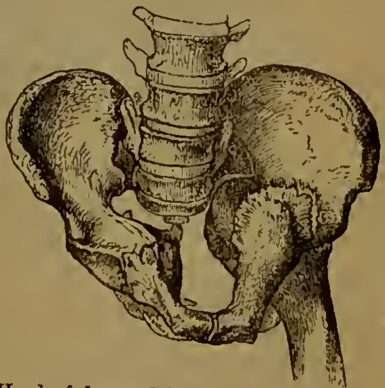
Fracture of the acetabulum, from the head of the femur being driven against the bone, has been recorded. Earle, in the nineteenth volume of the 'Med.-Chir. Trans.,' adduced a case in which the pelvis was broken into its three anatomical portions. Sir A. Cooper and Travers have recorded others. Moore, also, in the thirty-fourth volume of the same Transactions, has given another with a drawing, as figured here (Fig. 500). When the head is driven into the pelvis, as illustrated in the drawing, there will be deformity of the hip, inability to move the limb, with pain in the attempt, and crepitus. Travers believed that acute pain on pressure upon the projecting spine of the pubes, and inability on the part of the patient to maintain the erect posture after pelvic injury, are diagnostic of *fissure of the acetabulum.*

Symptoms of fissured acetabulum.

A fracture of the *lip of the acetabulum* is probably present in such cases of dislocation of the hip as become displaced again after reduction; the head of the bone, having nothing to restrain it, slipping out of its cup. In these cases the reduction of the dislocation is usually attended with crepitus, followed by re-dislocation on the removal of the extending force. It should be treated by fixed extension, as in fracture of the thigh-bone, and some circular pelvic pressure. This accident is more frequently associated with dislocation of the head of the femur backwards than with any other.

Associated with backward dislocation.

Fig. 500.



Head of femur driven through acetabulum. 'Med.-Chir. Trans.,' vol. xxxiv.

Fracture of the sacrum may be regarded clinically like that of the pelvis; it is always the result of direct violence.

Fractures of the Lower Extremity.

Of lower extremity.

From hospital statistics these fractures appear to be more common than those of the upper extremity; but as the majority of cases of fracture of the upper extremity are treated as out-patients, and of which no records are kept, the conclusion is weakened by a fallacy. The Middlesex Hospital statistics, compiled by Lonsdale and H. Morris for sixteen years, tell us that there are 1206 examples of fracture of the lower extremity to 1932 of the upper, proving that fractures of the upper extremity are 23 per cent. more frequent than those of the lower.

Of the femur.

Fractures of the femur form about one fourth of all fractures of the lower extremity, and fractures of the neck about one fifth of the fractures of the bone. They may be divided into those (1) of the *neck or upper end*, (2) of the *shaft*, and (3) of the *lower or condylar end.*

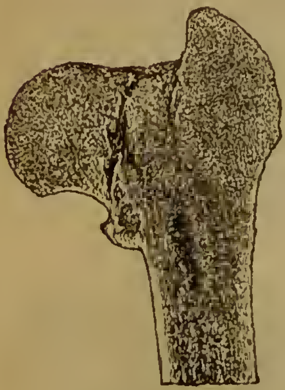
Of its neck.

Fracture of the neck or upper end existed in 44 out of 217 consecutive cases admitted into Guy's, or in one fifth of all cases. It is more frequent in the old than in the young, probably from the impaired nutrition of the bone, the cortex in the aged being always thinner and the cancelli larger. I have, however, seen it in a boy, æt. 12, and a man, æt. 27. Stanley and Hamilton have recorded examples at even an earlier age. In Guy's Museum there is a specimen taken from a child æt. 9 (Prep. 1184).

Intra- and extra-capsular fractures.

When the fracture involves the neck near the head of the bone it has been called "*intra-capsular*" (Figs. 500A and 504), when the base of the neck near the trochanters, "*extra-capsular;*" but in these the joint is generally involved, the line of fracture, as a rule, being oblique from the neck within to the base of the neck without the capsule. Both forms may be impacted; the former is so frequently, the latter generally.

FIG. 500A.



Intra-capsular fracture.

Intra-capsular fracture of the neck of the femur, showing ligamentous repair.

In the fractures of the neck near the head of the bone, the neck of the bone is usually driven into the head (Fig. 504). In the fractures of the base of the neck the neck is, as a rule, driven into the shaft (Figs. 475, 501-2). In exceptional cases the impaction is double (Fig. 505).

Fractures of the narrow part of the neck of the femur are generally caused by *indirect* violence, such as tripping in the carpet; fracture of the base of the neck by *direct*, such as a fall upon the trochanter. When the *posterior* ridge of bone penetrates the trochanter there will be eversion of the foot, the outer surface of the trochanter looking backwards, and the anterior surface of the neck will be felt as a prominent projection beneath the rectus muscle. When the *anterior* ridge of bone penetrates the lower fragment the foot will be straight or inverted, the surface of the trochanter will look outwards, and a great fulness will be felt behind the trochanter. Should the limb be much *adducted* when the patient falls upon the trochanter the lower border of the neck may be driven into the trochanter, as seen in Figs. 475, 501, and should the limb be much *abducted* when the fall takes place, the fracture will probably be in the narrow part of the neck, and, therefore, unimpacted and intra-capsular. When the penetration of the neck is great the trochanter will be broken off, and there will be no impaction, but the usual unimpacted fracture of the neck.

Impacted and unimpacted.

With these facts before us, the best division of fractures of the neck of the femur, for practical purposes, seems to be into the "*impacted*" and "*unimpacted.*"

Sir A. Cooper recognised this fact of impaction to a degree, though he did not quite see its importance, when, in describing fractures of the upper part of the thigh-bone, he wrote, "The fracture is placed at the root of the neck of the thigh-bone, the trochanter is split, and the neck of the bone is received into its cleft. It frequently happens in this injury that the fracture of the neck of the thigh-bone is complicated with an injury of the trochanters, major and minor; the neck of the thigh-bone is forced at times into the cancelli of the major trochanter." To the late Professor R. W. Smith, of Dublin, the thanks of the profession are unquestionably due for having given prominence to this class of cases, and in his valuable work on 'Fractures' in the vicinity of joints, published in 1850, will be found nearly all that is known about the subject.

All extra-capsular fractures at first impacted.

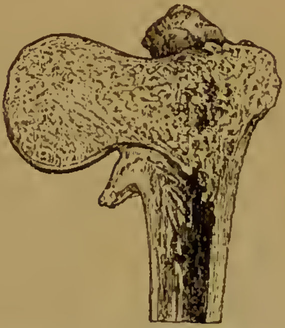
Impaction dependent on amount of violence.

Impaction very general in all forms of fractured neck.

Crepitus, as a means of diagnosis, condemned.

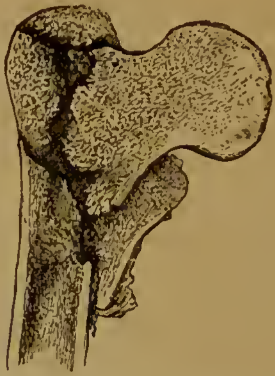
I am fully prepared to endorse his opinions, and agree with him, "that all extra-capsular fractures are, in the first instance, also impacted fractures." I believe, moreover, that many so-called intra-capsular fractures and all mixed forms are primarily of a like kind, and "that it depends principally upon the violence with which the injury has been inflicted, whether the neck of the bone shall remain implanted between the trochanters, or whether these processes shall be so completely separated from the shaft of the femur as to allow of the escape of the cervix from the cavity which it had formed in the reticular tissue of the lower fragment. If the force had not been very great the neck of the femur remains wedged in between the trochanters, and one or both of these processes are split off from the shaft; and if the fibrous structures around the neck of the bone and trochanters have not been injured, these broken portions of the trochanters are still held firmly in their places, and the cervix does not become loosened (Fig. 501); but if the force has been considerable, the impulse prolonged, the bone in a state of senile atrophy, or if, as frequently happens, the patient in endeavouring to rise falls a second time, then, under these circumstances, the trochanters are not only broken from the shaft of the femur, but are so far displaced and separated from their connection with the soft parts that the cavity or socket, as it were, into which the superior fragments has been received is destroyed; the impacted cervix thus set free no longer opposes the ascent of the inferior fragment, and the case then presents the characters of the ordinary extra-capsular fracture with great shortening of the limb" (Fig. 502). In fact, the ordinary fracture of the base of the neck of the thigh-bone is primarily an impacted fracture, the impacted bones in some cases being loosened by a second fall, in others by excess of violence received in the original accident, and *in too many by the manipulation of the Surgeon in his anxiety to make out the presence of a fracture by the detection of crepitus.* Indeed, this seeking for crepitus in cases of fracture is a practice fraught with danger. In fractures of the neck of the thigh-bone it is not only unnecessary because the diagnosis of the case can be made out without it, but it is unjustifiable, as the attempt to find it in every case of impacted fracture is often attended with irreparable mischief.

FIG. 501.



Impacted fracture of the neck of the thigh-bone, from the museum of my father, the late Mr. T. E. Bryant. Prep. Guy's Mus., 1187^{55}.

FIG. 502.



Comminuted fracture of the upper part of the thigh-bone, from the neck being driven into the shaft. Prep. 1194, Guy's Mus.

Diagnosis of impacted fracture.

Symptoms of Fracture of the Neck.—The diagnosis of fracture, impacted or otherwise, is a point of considerable importance, but that of an impacted fracture is particularly so, since it is not to be disputed that the recovery or degree of lameness of many a patient depends upon a correct appreciation of the value of such symptoms as usually exist in this variety of fracture, and that, too, in a very critical period of the case. Should an error in diagnosis be made, and the case being one of impacted fracture be overlooked, violent manipulative efforts will probably be made to reduce the supposed dislocation or to set the supposed fracture; or, what is equally probable, to decide the question between the presence of the two by the detection or non-detection of crepitus. As a consequence of this violence, the impacted bones to a certainty will be loosened, if not worse disturbed, and the case will be changed from one in which the bones were placed favorably for union and recovery, into another in which a very different set of circumstances has to be encountered and a less favorable prognosis has to be given.

Symptoms.

Happily, however, the diagnosis of these cases is not difficult, and the symptoms that indicate the presence of an impacted or non-impacted fracture are fairly characteristic. Those of an ordinary non-impacted fracture of the neck of the thigh-bone in any position are —some slight indirect or violent direct force; a "*shortening*" of the limb from one to two and a half inches; "*rotation outwards*" of the limb with eversion of the foot from mere gravity; inability *to raise the limb* on the part of the patient, but greater movements of the limb by the Surgeon's hands; "*swelling,*" according to the character of force employed and time after injury; "*pain,*" and occasional "*crepitus.*" In rare cases of non-impacted fracture of the neck, the foot may be inverted and thigh even flexed. Those of an impacted fracture are—a blow or *fall upon the trochanter,* followed by more or less complete *loss of power* in the limb; *shortening* to the extent of half an inch or one inch; a *fixed, everted, inverted,* or *straight* position of the foot, which moderate extension will *not* rectify; and, when the impaction is great, an approximation of the great trochanter to the median line of the body (Fig. 502A). The head of the bone will rotate in the acetabulum, and the trochanter with it, the rotation, however, of the trochanter taking place through an arc of a circle of which the head of the bone is the centre, instead of upon the axis of the shaft as in detached fracture of the neck. There will be indistinct or no crepitus. Local pain will always be felt on pressure behind the trochanter, and local thickening within a few days of the accident.

FIG. 502A.

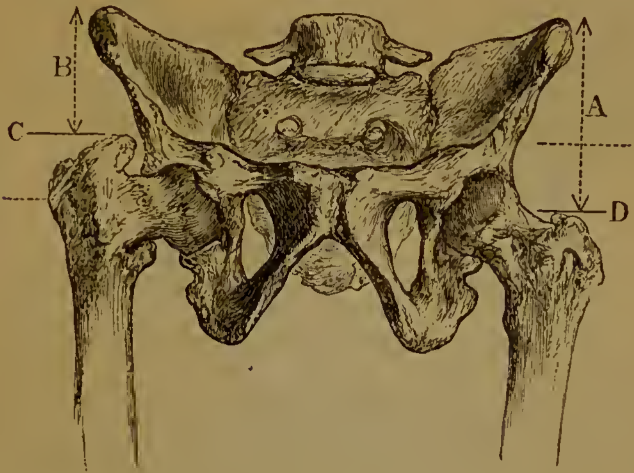


Figure showing how the trochanter of the fractured bone is drawn upwards nearer the anterior superior spine of the ilium. A. Normal length of base of ilio-femoral triangle (Fig. 503). B. Shortened base of ileo-femoral triangle. C. Horizontal level of fractured bone. D. Horizontal level of sound bone.

Eversion or inversion of foot.

When from the direction of the force applied to the trochanter the *posterior* wall of the neck is driven into the inter-trochanteric line, the limb will be rotated outwards and the foot *everted;* and, when the *anterior* wall is driven into the bone, there will be *inversion* of the limb. The former form of accident is far more common than the latter, on account of the greater thinness of the posterior wall.

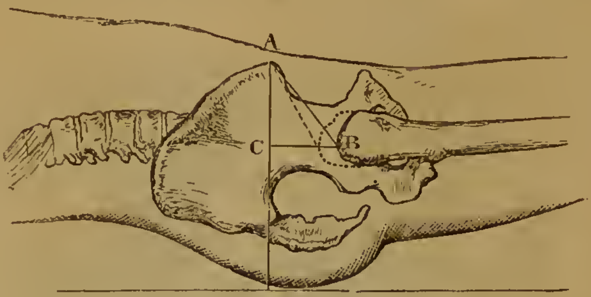
Test-line for fracture.

To make out the existence of shortening of the neck of the thigh-bone and its amount, Nélaton's line is most inconvenient since it necessitates the semi-rotation of the patient over towards the sound side, and consequently it includes the risk of causing displacement of the bones. My own test-line has no such objection, and can be applied to the patient in the horizontal posture. I have used it for many years, and found it of great value; indeed, as a proof of its use I may add that forty-two consecutive cases of fracture of the neck of the thigh-bone admitted into my wards to the end of 1883 (the average age of the patients being 70) left the hospital with union of the broken bones and useful limbs. Only one patient, æt. 79, died, and she did so with the fracture, though not from it, but from sloughing of the skin in her lumbar region from injury sustained at the time of the accident. In

Statistics.

two only of the forty-two cases was there any bedsore, and these gave no trouble. All were treated with the double splint (Fig. 507). The diagnosis of all these cases had been made by means of the test-line I now describe, and with the gentlest manipulation. ('Lancet,' January 22nd, 1876.)

Fig. 503.



The ilio-femoral rectangle A B C. C B. Test-line for fracture or shortening of the neck of the thigh-bone.

Ilio-femoral triangle.

Its formation.

For purposes of demonstration I have described it as the base of the ilio-femoral triangle (C B, Fig. 503), the two sides of the triangle being made up of two lines drawn from the anterior superior spinous process of the ilium, one of them, A C, being vertical, and traversing the outside of the hip to the horizontal plane of the body; and the second, A B, impinging on the tip of the trochanter major and corresponding in the normal condition of the hip-joint to the anterior half of Nélaton's test-line for dislocation of the head of the femur backwards.

Its use.

The "test-line" C B for fracture or shortening of the neck, joins the two at *right angles* to the vertical line, and extends from it to the trochanter. Any shortening of this line, on comparing it with the same taken on the uninjured side, indicates with precision a shortening of the neck of the thigh-bone; and, when the shortening has immediately followed an injury, fracture of the neck of the thigh-bone, impacted or otherwise, is certain. Compared with this line, all other measurements are uncertain. By its use, manipulations of the injured limb are rendered unnecessary. For practical purposes, the vertical line A C and the test-line C B are alone required. To compare the two sides of the body it is necessary to see that the pelvis is straight.

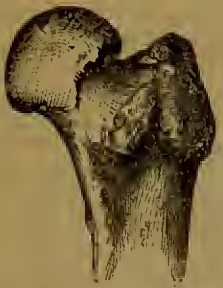
My friend Mr. H. Morris has likewise a ready method of measuring those parts, which he calls the bi-trochanteric measurement (*vide* 'Holmes' Syst.,' vol. i, 3rd ed., p. 1003).

Sources of fallacy.

The symptoms thus described, taken as a whole, may be looked upon as pathognomonic of an impacted fracture; for, although there are other injuries to the hip-joint which may give rise separately to many of the symptoms detailed, there are none in which all or most are found combined. There is no injury to the hip-joint in which the head of the femur rests and can be made to rotate in the acetabulum and in which *immediate shortening* is ever found, with the exception of a fracture; and there is no form of fracture that occurs under like circumstances, with the exception of the impacted, that is not accompanied by crepitus that can be readily detected, with complete eversion of the foot, marked shortening, and loss of power over the limb.

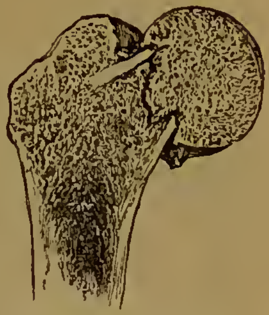
These points are well brought out in a paper in the 'Med. Times' of 1869, in which I gave a careful analysis of fourteen cases.

FIG. 504.



Impacted intra-capsular fracture of the neck of femur repaired. Case of the late Mr. T. E. Bryant. Prep. 1187^{50}, Guy's Mus.

FIG. 505.



Doubly impacted fracture of the neck of the thigh-bone.

Meaning of sudden shortening.

Of gradual shortening.

When sudden increase in the amount of shortening takes place some days after an injury to the hip, the separation of the impacted bones and the drawing up of the lower fragment should be suspected, and, when some gradual shortening follows, it signifies the absorption of the injured neck of bone.

Eversion.

The eversion of the limb as found in the non-impacted fracture is due to the simple weight of the broken limb, aided by the action of the powerful external rotator and possibly of the adductor muscles. The position of the limb in the impacted fracture, whether slightly everted, straight, or inverted, is determined by the impaction of the anterior or posterior wall of the neck, and by the fact that the foot will be fixed by the impaction in the position in which it existed at the time of the accident.

In non-impacted fracture of the narrow end of the neck or true intra-capsular fracture, there is usually less shortening than in the non-impacted fracture of the base; this symptom depending in both of these cases upon the amount of separation of the fibrous covering of the broken bone. In the former, crepitus is also less distinct. In both these forms the shortening will be made to disappear by extension, whilst in the impacted, in any of its varieties, no such effect will be produced by ordinary force.

It can only be by carelessness that a contused hip is mistaken for a fractured thigh, impacted or otherwise. I have, however, known this error to be committed.

Bigelow's views.

"The practical importance of readily identifying this fracture," writes Bigelow in his valuable monograph on the hip, "lies in the fact that its progress, as regards both time and good union, is in general more favorable than that of the unimpacted fractures; that though it is a comparatively common and disabling accident, it may exhibit little deformity, and, lastly, that the object of extension in its treatment is to steady the limb, and not to draw it down."

Treatment.

TREATMENT.—If it were as distinctly understood as it should be by all students and practitioners that a fracture of the neck of the thigh-bone can be diagnosed without seeking for crepitus; that all but the gentlest manipulation of an injured hip is likely to prove injurious, and that any attempt to elongate the limb by forcible extension, to flex it or to rotate it with the view of restoring it to its natural position is likely to be followed by a breaking up of the impacted bones and consequently by irreparable injury, the treatment of these cases would be as satisfactory in its results as it is simple, and our workhouses would be occupied with fewer cripples. If, moreover, it was recognised, as it should be, that many intra-capsular and all extra-capsular fractures unite when rightly treated, every case of fracture of the neck of the femur, impacted or non-impacted, intra- or extra-capsular, in the young, middle-aged, or old, would be treated as if repair and union were sure to take place if the parts are kept at rest and in apposition; and, in the large proportion of cases, the hopes of the Surgeon will not be disappointed (*vide* statistics of my own cases, p. 441). In the purely intra-capsular fracture, union may take place, osseous in many cases (Fig. 504), fibrous in more (Figs. 500A and 508). In a few there will be none, owing to a total separation of the head of the bone from its attachments, or to the feeble power or age of the patient, or because the broken fragment receives too little nourishment to allow of sufficient reparative material being poured out, or because the fractured bones have not been kept sufficiently at rest and in apposition. Under these circumstances the head of the femur will be loose in the acetabulum with its broken surface smoothed into a cup-shaped cavity, where the rounded end of the broken neck of the femur plays as in a false joint.

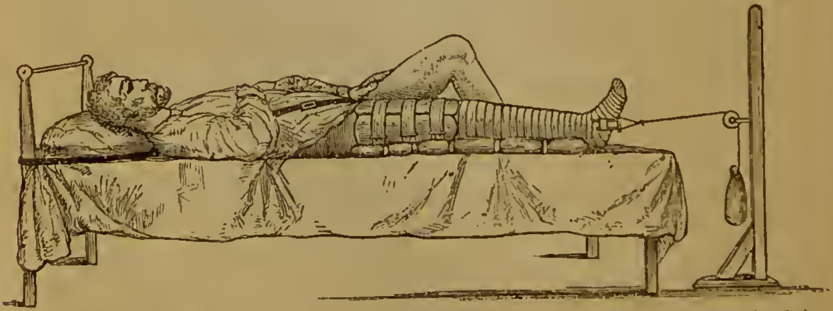
Of impacted fractures.

In the impacted fractures, union ought to be looked for if the broken fragments are left alone and not loosened by a careless or too curious manipulation.

Value of double splint.

In the non-impacted, extension is to be more thoroughly employed. The best splint for these purposes is my double one (Fig. 507). By it, in the non-impacted fracture, the limb should be brought down to a level with its fellow, and maintained there by means of the elastic extension pulley; by its means both limbs are kept parallel, no pressure is applied over the trochanters; abduction or adduction of the limb is prevented, and extension is maintained. With this splint no perineal band is required if the foot of the bed is raised two or three inches.

Fig. 506.



Gurdon Buck's method of applying extension in a case of fracture of the neck of the thigh-bone.

In the impacted fracture enough extension is required to neutralise muscular action, but no more.

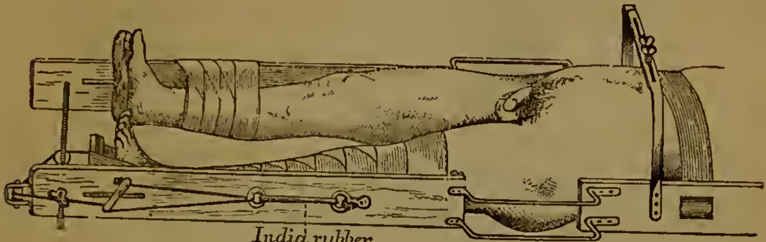
Buck's method by weights.

Gurdon Buck's method of applying extension to the limb by means of weights has found great favour of late years in America and this country, and is doubtless very good and simple, the counter-extending force being applied by means of a perineal band of india-rubber tubing fastened to the head of the bedstead or splint, while the limb is steadied by means of long sand-bags applied laterally, or short thigh-splints (Fig. 506). This plan, however, has the disadvantage of not preserving sufficient immobility of the broken bones, and ought, therefore, only to be employed in conjunction with the long splint.

Double inclined plane.

Sir A. Cooper's plan of placing the patient on a double inclined plane has few advantages when union is to be looked for, and even the broad, well-padded belt which he applied round the pelvis in order to keep the broken fragments closely together cannot be recommended; still, where the long splint cannot be worn the inclined plane may be substituted.

FIG. 507.



Double splint for fracture of the shaft or neck of the thigh-bone and hip disease.

Immovable bandage.

When the necessary confinement to the supine position cannot be tolerated and bed-sores appear, it may be necessary to give up the long splint, and, under these circumstances, it is wise to fix the hip, pelvis, and thigh in some strong, immovable casing similar to that employed in hip disease (Fig. 552, p. 497), the limb being kept extended by means of weights attached to the foot during the setting of the material. The casing may be of plaster of Paris, leather, felt, perforated zinc, or flannel, with starch, or gum and chalk.

To allow the patient to get up without any apparatus is not only to give up all hope of a cure by union, but to add to the local irritation; as the broken fragments will grate against one another and irritate the soft parts around, often causing severe local and constitutional disturbance. Under all circumstances, however, immobility of the broken bone is to be ensured.

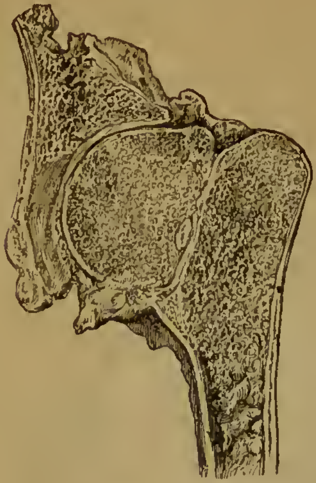
Interstitial absorption of the neck.

Interstitial absorption of the neck of the bone is sometimes met with after fracture, and in Fig. 508 the fact is well illustrated, the neck of the bone having almost entirely disappeared, as will be seen at once on comparing a section of the injured bone with that of the uninjured, from the same subject (Fig. 509). It is said also to take place after a contusion without any fracture in osteo-arthritis; how far it may occur otherwise is an open question. My own impression is that in all such cases some fracture existed, though it is difficult to prove the truth of such an opinion. The question requires further elucidation.

Fracture through the trochanter.

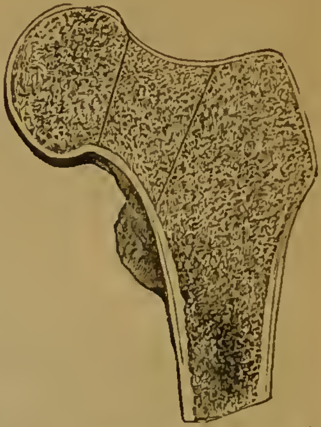
Fractures through the trochanter occasionally occur. Sir A. Cooper describes them as oblique fractures not implicating the neck of the bone, and can be made out by the immobility of the lower portion of the bone whilst the upper part is fixed, and by the other signs of fracture, such as crepitus, &c. They should be treated like fractures of the neck.

FIG. 508.



Fracture of the neck of the thigh-bone within the capsule, repair of fracture by means of bone, fibrous tissue and fibro-cartilage; absorption of the neck of the bone. Prep. removed from woman, æt. 60, who had received the injury five years before.

FIG. 509.

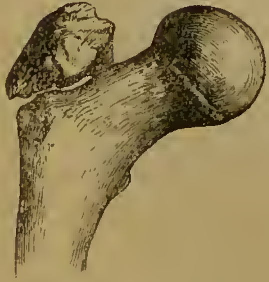


Femur of the opposite side showing the amount of bone absorbed.

Separation of epiphysis of head.

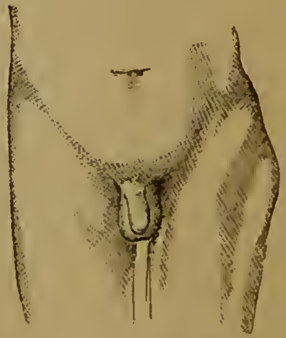
Separation of the epiphysis of the head of the bone has been described. South has recorded such cases in his 'Chelius's Surgery,' and Post, of New York, in the 'New York Journal,' vol. iii, but no preparation exists to demonstrate the fact. It is, doubtless, possible in the young, and would be known by some such symptoms as those

FIG. 510.



Mr. Aston Key's case. Prep. 1195, Guy's Mus.

FIG. 511.



Appearance during life. Mr. Poland's case.

Fracture of the epiphysis of the major trochanter.

of fracture of the neck, crepitus being exchanged for what South calls a "distinct dummy sensation" on rotating and extending the limb. As a consequence of disease, it will be described in a later chapter

Of epiphysis of great trochanter.

Separation of the epiphysis of the trochanter major is a more definite accident, and doubtless has occurred. Sir A. Cooper recorded a case which Mr. Aston Key had observed, and the diagnosis was verified after death. In it, the detached fragment, however, was not displaced, but held in position by means of its fibrous and tendinous coverings; the separation was the result of direct local violence; abduction of the limb caused great pain, but all other movements were allowed. The preparation exists in the Guy's Museum, 1195, and is figured above (Fig. 510). A like case occurred in the practice of the late Mr. Poland, at Guy's, in 1871, which through his kindness I saw. It occurred in a boy, æt. 12, from a direct blow, and was characterised by a projection and thickening of the trochanter (Fig. 511). Similar instances have also been published by Dr. Roddick, of Montreal ('Canada Med. and Surg. Journal,' Nov., 1875), Mr. McCarthy ('Path. Trans.,' 1874), and Agnew in his 'Surgery.'

Fracture of the Shaft of the Femur.

Fractured shaft.

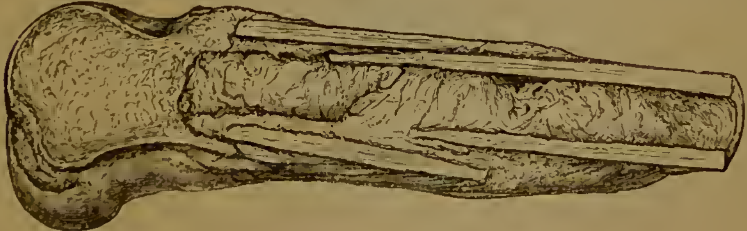
Cause.

This may take place in any part, but is more common in the centre than elsewhere, and, as a consequence, of indirect violence; it may occur, however, as a result of direct force, and more rarely of muscular action. From this cause I have seen it from the swinging of the limb over the side of a cart in the act of descending, and, in an epileptic patient, from the spasm of the muscles, with the patient in bed. I have known it also to take place from the same cause when cancer of the bone existed.

Direction.

The fracture may be *transverse*, *oblique* in any direction, *vertical*, *dentated*, *comminuted*, or *impacted*, the nature of the force and its direction determining these points; a sharp blow is likely to be followed by a transverse fracture; a crushing force by a comminuted one; an indirect fracture probably will be oblique, according to the natural bend in the lower part of the limb. In the upper third, the bone may be broken oblique from above, and in front downwards and outwards; and from impaction of the lower extremity into the upper, the latter fragment may be comminuted, the bone splitting secondarily upwards into the neck. Dr. E. H. Bennett, of the Dublin University, has written an interesting

FIG. 512.



Impacted fracture of the shaft of the femur produced by a fall upon the knee in a man, æt. 83.

Impacted shaft.

paper on this form of fracture ('Brit. Med. Journ.,' June 26, 1880). In the middle of the bone, a lateral obliquity is the most common; in the lower third, an obliquity from behind forwards. Fractures may also be double in the same bone or compound. In the case illustrated (Fig. 512) the fracture was impacted, the upper fragment having been forced into the hollow of the lower, which it has split. It occurred in a patient under my care in 1876, æt. 83, from a fall down an area upon his knee. The man died on the twenty-ninth day from kidney disease ('Path. Soc. Trans.,' vol. xxix, 1878).

Displacement.

The displacement that takes place turns much upon the line of the obliquity and the position of the fracture. In fracture below the lesser trochanter, the upper fragment is prone to be drawn forward by the action of the psoas and iliacus muscles, and outward by the external rotators. In fractures above the condyles, the lower fragment is apt to be drawn backward by the unantagonised action of the gastrocnemii muscles. In fractures of the centre of the shaft, the deformity depends on the line of obliquity. Rotation outwards of the lower fragment is found in nearly every case.

Diagnosis.

There is usually no difficulty in diagnosing a fracture of the shaft, the following symptoms being usually present:—A fall or injury, followed by loss of power in the limb; shortening, which extension can rectify; deformity, probably angular; extra mobility of the lower part of the injured limb; crepitus; and probably the projection of one end of a fragment with eversion of the foot. When the fracture is transverse, the shortening will rarely be marked; when it is oblique, the direction of the angular deformity often indicates the line of the obliquity.

Of incomplete fracture.

In young children where the fracture is incomplete, shortening with bowing of the limb after an accident, and an indistinct sensation of yielding on manipulation, with or without a peculiar crackling sensation, indicate the nature of the accident.

Treatment.

TREATMENT.—The fragments having been carefully adjusted by means of extension and gentle manipulation, the mechanical treatment of these fractures consists in the maintenance of extension by means of some applied force and the complete rest of the co-apted bones; gentle compression of the affected part being sometimes beneficial. To assist the Surgeon towards these ends, some anæsthetic may be used if the pain be severe and it is impossible by other means to keep the patient at rest, and any spasmodic action of the muscles interferes with the Surgeon's aims.

Double splint.

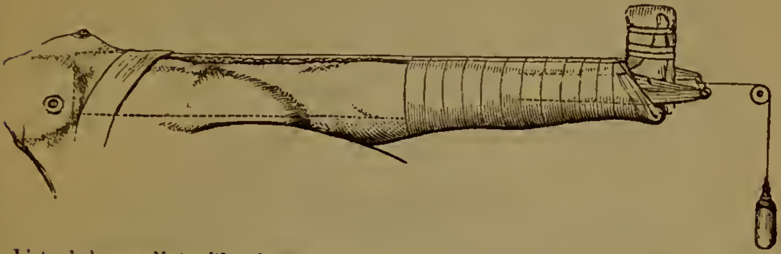
Statistics of.

For many years past I have used no other splint than the double one seen in Fig. 507 and 550, and most Surgeons who have employed it once, adopt it. It does not shift from its place because the interruption over the trochanter renders it comfortable; it keeps the fractured limb still, and maintains it parallel with its fellow: extension can be carefully and easily regulated by means of the extension elastic pulleys; and no perineal band for counter-extension is needed; the results, moreover, which have attended its use are excellent. Thus, out of 100 cases consecutively treated in my wards with this splint, in fifty-two there was no shortening, in thirty-six there was half an inch or under, and in twelve only was there one inch. Four other cases died: one, æt. 81, from senility; one, æt. 83, on the twenty-ninth day, from kidney disease; one, æt. 40, from abscess of the lung, on the twenty-third day; and one, æt. 45, from delirium tremens, on the eighth day.

Liston's splint.

At other schools other means are adopted, according to the fancy of the Surgeon and the fashion of the school. Thus, in hospitals where the Scotch influence is great, Liston's long splint is the one usually employed, which should extend well up into the axilla, and several inches below the foot (Fig. 513, without foot-piece). It ought to be well padded and supplied with a soft perineal band, such as a leather strap, or a piece of india-rubber tubing. The ankle and instep should be well protected from pressure by cotton-wool, and the retaining bandage applied with equal pressure.

Fig. 513.



Liston's long splint with a footpiece attached, with weights for extension in fracture of the neck of the thigh-bone.

Desault's splint modified.

Where the long splint is employed, Desault's splint, with a foot-piece (Fig. 525), and the addition of a cross-bar for steadiness should be preferred. The splint may be of wood or metal, and made with a slide so as to be adjusted to different patients. All long splints, however, without an interruption over the trochanter, as seen in Fig. 507, to guard against pressure, are inefficient and most uncomfortable.

Double inclined plane.

In fractures of the upper third, where the upper fragment is apt to tilt forward and be rotated outwards, the double inclined plane is often of great value. It should be employed, however, only when the long splint fails to fulfil the objects the Surgeon has in view. It is daily dropping out of use.

Hodgen's splint.

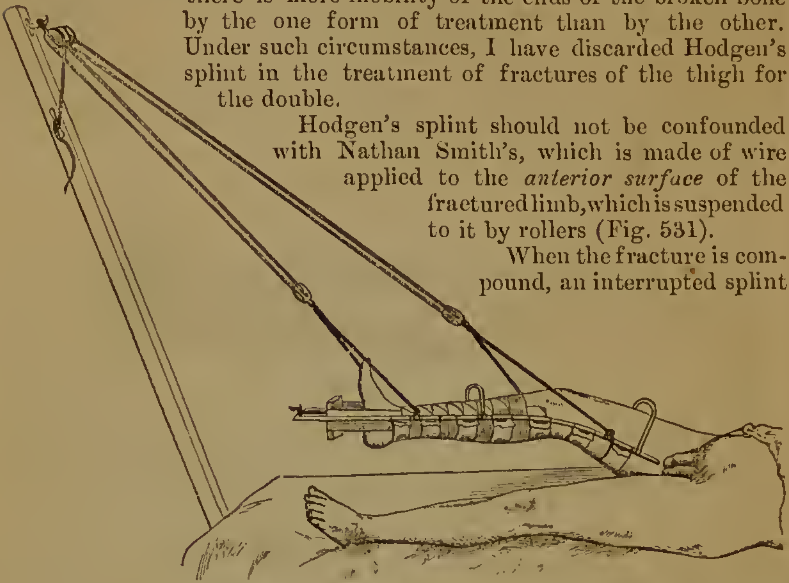
A splint full of promise was introduced in 1875 into practice at Guy's Hospital (Fig. 514) from the Marine Hospital, Greenwich, and is still used by some of my colleagues. It is a modification of one invented by the late Dr. J. T. Hodgen, of St. Louis, U.S. ('Treat. on Mil. Surg.,' by F. H. Hamilton, 1865, p. 411), for gunshot fractures, and is made of galvanized iron wire (No. 2). In it the injured limb may be supported on a piece of flannel, which is slung to the iron rod, or, upon pieces of bandage. Extension is kept up by means of the strapping attaching the foot of the injured limb to the lower cross-bar of the splint, and through the suspending cords and pulleys. The counter-extension is maintained by the weight of the limb above the fracture and weight of the body. The splint, as seen in Fig. 514, is most comfortable to the patient, and an old house surgeon, Mr. J. F. Fry, reports ('Guy's Gazette,' Dec. 11, 1875) that out of seventeen cases of fracture of the thigh consecutively treated with the splint, the average amount of shortening was less than half an inch, and that in six cases there was not any. I have found, however, after a

Its success.

Double splint.

lengthened trial of this splint, that a much larger amount of callus is thrown out about the seat of fracture than is met with when the bones are kept perfectly at rest, and as they are by the double splint (Fig. 507, p. 445), and conclude from this fact that there is more mobility of the ends of the broken bone by the one form of treatment than by the other. Under such circumstances, I have discarded Hodgen's splint in the treatment of fractures of the thigh for the double.

Fig. 514.



Dr. J. Hodgen's suspension splint, as used at Guy's.

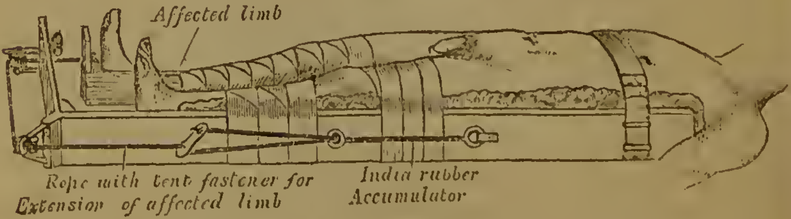
Hodgen's splint should not be confounded with Nathan Smith's, which is made of wire applied to the *anterior surface* of the fractured limb, which is suspended to it by rollers (Fig. 531).

When the fracture is compound, an interrupted splint may be employed. In addition to the long splint, short additional splints applied in front, or the inner side of, or behind the thigh as the want of the individual case may suggest, are of great value to ensure greater steadiness of the broken bone. In no case should the seat of fracture be covered in. The bandage should stop below, and, if necessary, recommence above it. To prevent the bandage slipping after it has been applied, it is a good plan to give it one coating of paste or glue.

De Morgan's plan.

Many modifications of these means might be mentioned. Thus, Paget has very generally employed Busk's long splint, in which a joint exists opposite the hip, which enables the patient, after union has taken place, to sit up without affecting the thigh-bone. The late Mr. C. de Morgan, of the Middlesex Hospital, applied the extension to the fractured limb by means of a force carried from the foot through a pedal cross-bar to a long splint applied to the opposite limb (Fig. 515).

Fig. 515.



Mr. Campbell de Morgan's splint, with elastic extension.

Sir W. Fergusson was wont to apply his counter-extension from a strong stay of jean, carefully fitted to the upper third of the opposite thigh, from which a band extended in front and behind to the upper end of the splint, thus doing away with the perineal pad.

During the application of the long splint, steady traction should be maintained on the injured limb by a competent assistant. When muscular spasm is severe, some Surgeons have advised temporary pressure on the femoral artery in the groin. It is said to stop the spasm in all cases, and whenever I have tried it, it answered well.

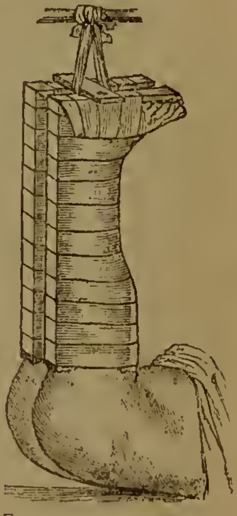
Vertical Extension.

In infants.

In infants and children under three years of age fractures of the thigh are treated with difficulty, for any immovable apparatus is constantly dirtied from urine, fæces, &c., and requires to be changed, and the good that would otherwise be experienced is thus neutralised. On this account Paget and Callender have treated, within the last few years, many cases of fracture of the thigh in children, without splints, all apparatus being dispensed with, "the child being laid on a firm bed, with the broken limb, after setting it, bent at the hip and knee, and laid on its outer side" ('St. Barth. Hosp. Rep.,' 1867). I do not recommend this practice, but would advise instead that the injured limb of the child, with the sound one, be flexed at a right angle with the pelvis, fixed by some light splint and hoisted upwards to a cradle, hook, or bar above the bed (Fig. 516). By these means the weight of the body acts as a constant counter-extending force, the child can be well looked to for purposes of cleanliness, and a good result may be expected. Kümmell, of Hamburg ('Berlin. Klin. Woch.,' No. 4, 1882), holds this method of vertical extension in fractured thighs in infants to be the best. He says, though wrongly, it was first tried by Schede, of Berlin, in 1877, and publishes a list of twenty-eight cases so treated in infants under two years. In justice to Guy's, however, I must state that I began this form of practice at Guy's Hospital in 1870, and have before me a list of twenty-eight cases so treated since in children varying from eight months of age up to five years—later than that age I prefer the double splint.

Vertical extension.

FIG. 516.



Fracture of the femur in a child treated by vertical extension.

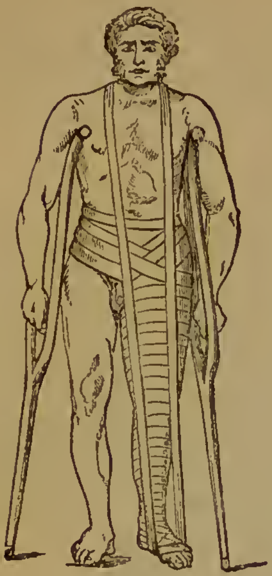
Immovable bandage.

Splints of gutta percha, felt, or leather may be used with the weights when they can be applied; some immovable apparatus being adjusted after the second week; indeed, in some cases this immovable apparatus may be applied at once, care being taken that the limb is kept well extended during its application and setting. The Bavarian flannel splint is the best (Fig. 476).

In adults, also, after the fourth week, this same immovable apparatus may be employed with advantage, the patient gaining greater freedom. Some Surgeons think so well of this plan as to advise its use in fracture of the thigh from the very first. Erichsen, its ablest advocate, says

('Science and Art of Surgery,' p. 225), "The starched bandage may be employed in most cases. The limb should be evenly and thickly enveloped in a layer of cotton wadding; a long piece of strong pasteboard about four inches wide, soaked in starch, must next be applied to the posterior part of the limb from the nates to the heel. If the patient be very muscular, and the thigh large, this must be strengthened, especially at its upper part, by having slips of bandage pasted upon it; two narrower strips of pasteboard are now placed, one along each side of the limb, from the hip to the ankle, and another shorter piece on the fore part of the thigh. A double layer of starched bandage should now be applied over the whole with a strong and well-starched spica (Fig. 517); it should be cut up and trimmed on the second or third day, and then reapplied." With such an apparatus Erichsen has treated many fractured thighs, both in adults and children, without confinement to bed for more than three or four days, and without the slightest shortening or deformity being left. The points to be especially attended to are, that the back splint be very strong at the upper part especially, and that the spica be well and firmly applied, so that the hip and the whole of the pelvis be immovably fixed.

FIG. 517.



From Erichsen.

Fractures of the condyles.

Fractures of the condyles necessarily involve the joint, and these may be transverse, oblique, or vertical (Fig. 518). In subjects under twenty-one *the lower epiphysis may be separated from the shaft,* thus simulating a transverse fracture (Fig. 519), or a dislocation (Fig. 464A).

Separation of lower epiphysis.

Serious in that the joint is implicated.

These cases are serious on account of the joint complication, as some stiffness of the joint generally, but not always, follows; this result depending upon the amount of inflammatory action that takes place after the injury. When the head of the tibia is fractured into the joint the same observations are applicable. In these cases the posterior splint, as suggested by MacIntyre (Fig. 530), is probably the best, the knee being slightly flexed. When joint complication exists, the application of ice, or probably some leeches, may be required.

Treatment.

May be impacted.

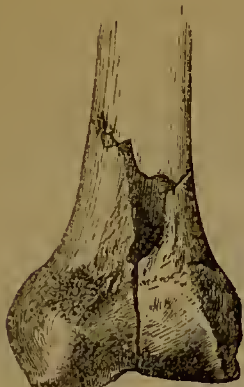
In exceptional instances the upper fragment of bone is driven into the lower, thereby giving rise to an impacted fracture. These cases, like other impacted fractures, generally do well by simple rest.

In all cases involving joints passive motion should be allowed at the end of five or six weeks.

Anterior splint.

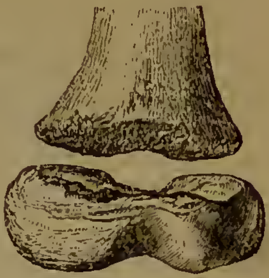
Nathan Smith, of New York, advocates the use of an anterior splint composed of a single piece of iron wire of the thickness of a No. 11 catheter, which is carefully bent to the inequalities of the limb and fastened to it by means of strapping and bandages, the limb being subsequently suspended to the ceiling by a cord connected with the wire above and below the knee, extension being made through this cord, and the counter-extension by so raising the foot of the bed as to tilt the body towards its head (Fig. 531, p. 463).

Fig. 518.



Fracture of the shaft of the femur, with longitudinal fissure through the condyles into the knee-joint. Prep. 1200, Guy's Mus.

Fig. 519.



Separation of the epiphysis. Prep. 1210^{45}, Guy's Mus.

Of lower third.

In fractures of the lower third above the condyles, where the gastrocnemii muscles tend to draw the lower fragment backward into the popliteal space, some Surgeons prefer the use of the inclined plane, and where the bones cannot be otherwise kept in apposition it is, probably, a sound practice. But what I believe to be a better one is the division of the tendo Achillis and the subsequent use of the long double splint. The division of the tendon paralyses the gastrocnemii, and thus allows the Surgeon to bring the bones into a good position, and to deal with them as with an ordinary fracture. I have taught this for many years and, having tested its value in three cases, can pronounce the practice to be good. My friend Mr. Treves, of the London Hospital, followed the practice in 1882 ('Brit. Med. Journ.,' Feb. 17, 1883), and it has likewise been practised by Dr. Morris, of Boston, in America, with success ('Boston Med. and Surg. Journ.,' Nov. 29th, 1877).

Division of tendo Achillis.

Compound Fractures of the Thigh.

Compound fractures of thigh.

These are desperate accidents, and take place in the proportion of one to every six or seven cases of fracture of the femur, and when they occur half the patients die. They should be treated, where possible, on conservative principles, and amputation should only be performed when the soft parts, with the vessels and nerves, are so injured as to forbid any reasonable hope of recovery. Conservative practice should have full scope in young subjects especially, and when any doubt upon the necessity of amputation exists, the Surgeon had better decide upon trying to save the limb, although in the aged an opposite practice should be adopted.

Amputation in.

Conservative practice.

Army Surgeons, however, advise the propriety of practising conservatism for gunshot fractures in the upper third of the thigh, and amputation for all fractures of the middle and lower thirds; the nature of gunshot injuries to those parts precluding all hope of a natural recovery. All modern army Surgeons—English, American, French, and German—agree upon this point, and endorse Dupuytren's, Hen-

In military surgery.

uen's, Larrey's, and Guthrie's opinion, that in gunshot wounds of the thigh, "in rejecting amputation we lose more lives than we save limbs," and "that in the exceptional cases which result in consolidation the condition of the limb is not encouraging."

Amputation of the thigh for compound fracture is most fatal, two out of three dying. In the upper third of the thigh, the mortality is still greater.

It is from this fact alone that army Surgeons have advised the conservative treatment of compound fractures of the upper part of the femur, and Mr. Erichsen has been led to assert, that amputation in the upper third of the thigh for compound fracture is an unjustifiable operation.

When amputation is not at once called for, the wound should be thoroughly cleansed with some iodine or other antiseptic lotion, and all foreign bodies with loose fragments of bone removed; the projecting portions of bone should be excised, bleeding arrested, and the wound sealed with blood or the compound tincture of benzoin, a splint should be applied at once, moderate extension employed, and the case treated on general principles.

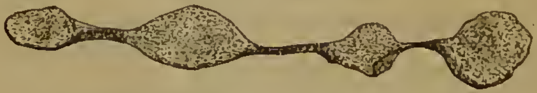
Fractures of the Patella.

Fractures of patella.

These are usually transverse from a sudden action of the quadriceps femoris, under a violent effort to prevent the body falling backwards, the knee being at the time partially bent. Such fractures are met with chiefly near though mostly below the centre of the bone; they may, however, occur at any part, even in the extra articular portion of bone. In some cases, both patellæ are broken, together or consecutively; in rarer instances, the same patella may be broken more than once. I have had such a case in a man in whom one patella had been broken twice and the other three times; and, in the Guy's Museum, there is a preparation (Fig. 520) from my father's museum, in which the bone had been broken transversely into four fragments, probably from different injuries or from some direct force, each fragment having a ligamentous union.

Multiple fractures.

FIG. 520.



Multiple fracture of patella. Prep. 1212^{20}.

May result from direct violence.

These transverse fractures are at times, although rarely, the result of direct violence. The French and American Surgeons believe them to be so very frequently. Direct violence to the patella, however, is more commonly followed by what is called a starred or vertical than a transverse fracture, and in these cases there is rarely much separation of the fragments. In transverse fracture the separation is sometimes very great, this fact mainly depending upon the amount of muscular action at the time of fracture. It is, however, greatly increased by the effusion of blood that follows the injury, and later on of inflammatory exudation. At a still later period it is increased from a yielding of the ligamentous tissue by flexing the leg, before firm union has taken place.

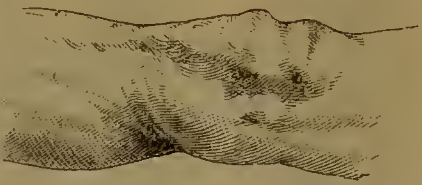
Statistics of recent fractures.

Out of 25 consecutive cases which passed under my care, in 7, on convalescence, the union was so close as to have been reported as bony; in 9 there was only separation of a quarter of an inch; in 8 of half an inch; in 1 of one inch. In all of these the movements of the joint were perfect.

Diagnosis.

The diagnosis of the transverse fracture is rarely difficult, the nature of the violence, the sudden loss of power of the limb, the distinct separation of the fragments, and the bulging of the synovial sac between the divided portions of bone, being characteristic. In the *starred* fracture the different pieces of bone may be made out. In the *vertical*, the diagnosis may be more difficult, and can be only made out by manipulation. In exceptional cases where either the ligamentum patellæ or the tendon of the extensors above the patella is broken, some difficulty may be felt, but such accidents are very rare. When the transverse fracture is little more than a fissure, no separation will be found, the amount of separation being determined by the extent of laceration of the fibrous and tendinous coverings of the bone. When the laceration is partial and the separation slight, there is a better hope of a bony or close union than when the laceration is complete and the separation great. It should be known, however, that union by bone may take place although probably but seldom; that union by strong ligament, with about half an inch of separation, is more common; and that non-union is exceptional. William Adams, in the 'Path. Trans.,' vol. xiii, informs us that, out of thirty-one specimens he examined, fifteen were examples of ununited fracture, twelve of true ligamentous union, and four doubtful. In the ununited the separation was very great, in the ligamentous, it was rarely beyond an inch and a half. In the ununited the separated fragments were only connected with each other by a single layer of fibrous tissue.

FIG. 521.



Fracture of the patella. Separation of fragments.

Starred and vertical fracture.

Character of uniting medium.

Bony union possible.

That bone union takes place is now generally recognised. In Prep. 1211^{57}, Guy's Museum (Fig. 522), taken from my father's museum, the fact is well exemplified. The specimen has been fully described with remarks, by the late Mr. W. King, in the 'Guy's Hos. Rep.,' series i, vol. vi.

In the starred or vertical fractures osseous union is generally secured, these cases being rarely attended with complete laceration of the periosteal or fibrous covering of the bone.

Treatment. Posterior splint.

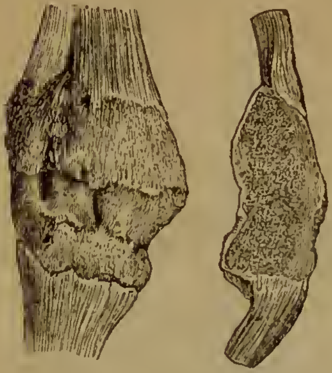
TREATMENT.—In all cases, as well as in every form of fractured patella, a long well-padded posterior splint with a foot-piece extending from the tuberosity of the ischium to the foot should at once be adjusted, the knee-joint being left uncovered by the bandage. To the knee-joint cold should be applied, for, as a direct consequence of the accident blood is very apt to be effused, and as a secondary effect, synovial inflammation with effusion is almost sure to ensue. Should the joint be hyper-distended with blood such may be removed by the aspirator.

It has generally been the custom to raise the heel with a view to

Elevation of limb not required.

destroy the action of the extensor muscles, but it is now more generally believed that no good is derived from such a measure; as a consequence the horizontal position of the limb is usually employed, the body being raised. The fragments should be brought together at the same time as much as possible by the fingers of the Surgeon, and later on by some apparatus. To do so, however, while blood exists to any extent, or the synovial capsule is distended with inflammatory effusion, is not wise; since any attempt to draw the bones together under these circumstances can only result in tilting forward the surfaces that are required to be brought into apposition, with no good effect.

FIG. 522.



Anterior surface. Vertical section.
Fracture of patella united by bone.

Rest.

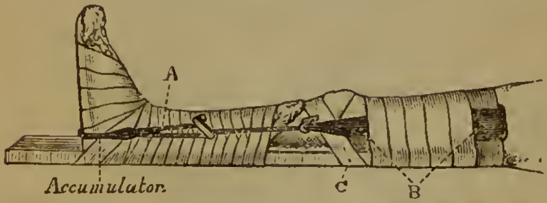
Elastic compression.

For a few days, therefore, until all inflammatory action has subsided, the Surgeon should rest satisfied by simply pressing the parts together with his fingers, and when this result has been secured the two portions may be drawn together by means of strips of plaster diagonally applied, of india-rubber bands covered with wash-leather attached to hooks, which have been inserted at intervals of an inch on either side of the splint, or, what is better, by means of elastic compression, as shown in Fig. 523.

Malgaigne's hooks.

Malgaigne's hooks, which are composed of four claws drawn together by a screw, have been much employed, and are doubtless effectual, but from the fact that they penetrate the soft parts and painfully and forcibly draw the broken fragments together they are objectionable. Good results have, however, been reported from their use.

FIG. 523.

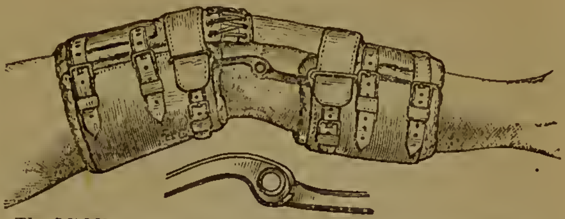


Splint for fracture of the patella, with elastic compression.
A. Cord with tent fastener to regulate extension.
B. Band or strapping bound to thigh.

Bavarian splint.

As soon as all inflammatory action of the joint has subsided, and the bones are fairly in position, such an immovable apparatus as the flannel Bavarian splint may be applied, the patella being left exposed or not, as the Surgeon may think fit. When the bone is bandaged over, care must be taken not to press upon it, as I have known secondary suppuration with necrosis, and joint complication of a serious nature thus ensue. Erichsen uses, as a rule, the starch bandage, and speaks highly of it. He applies it over a pad fixed above the fractured bone, with a figure-of-8 bandage. C. Heath removes fluid by aspiration, applies a plaster-of-Paris bandage over cotton wool, and allows his patient to get up. Whatever apparatus is employed, it should be kept on for five or six weeks at least, and when removed some light leather or felt casing should be substituted. To allow the patient to flex the limb under three months, and to give it freedom under a year, is hazardous, for the united ligament is apt to be stretched and elongated, and the limb weakened. An apparatus to limit the movement of the joint should be worn after this accident. One made by Hawksley, and long used at the Middlesex Hospital, is excellent (Fig. 523A). "It is applied as soon as the patient is allowed to get up; and the degree of flexion is gradually increased from time to time by filing away the shoulder of the joint of the splint."

Fig. 523A.



The Middlesex Hospital splint for fracture of the patella.

Operative interference in fracture.

Within recent times Surgeons have advocated the primary treatment of these fractures by wiring the fractured bones together, and successes have been obtained; some excellent, others indifferent, few better than the average obtained by the treatment above described. Sir J. Lister has been amongst the most successful. So far as I can make out, the first case recorded is by Dr. Uhde, of Brunswick ('Deutsche Medicin. und Wochens.,' April 27th, 1878). I cannot recommend this practice to be universally adopted; it is eminently hazardous, and when we know that in the majority of cases of fractured patella treated without operation results are obtained which in exceptional cases alone interfere with life's duties, the treatment by operation stands condemned as a rule of practice.

Statistics of old operations.

In 32 cases of old fracture of the bone which have been admitted into Guy's for other injuries; in 28 the limb was in all ways useful; in 4 only was it weak, and in these 4 the separation between the fragments was half an inch in 2, one inch in 1, and two inches in the fourth. Whereas in the patients with useful limbs, one man could go up a ladder with 2 cwt. on his shoulder; another acted as porter in a fish market; a third was a lighterman; two were coal porters; a sixth was a sailor; a seventh a carman; an eighth a marine engineer. In one man with a perfectly useful limb the fragments were three inches apart; in another who could walk well both bones were fractured, and the fragments two inches apart. In a cellarman who had good use of his leg the separation was four inches. In the majority of the good limbs the separation was about half an inch. Upon the whole, the result of the accident was most satisfactory, and enough to justify the ordinary modes of treatment employed.

In examples of neglected cases of fracture, where a great separation of the fragments exists and the knee is consequently so weak as to be useless, such an operation as has been described may be justifiable, but, under other circumstances, I cannot, as a teacher, regard it otherwise than as a rash and hazardous proceeding.

Compound Fractures of the Patella.

Compound fractures of patella.

These are grave accidents, one fourth of the cases dying. Poland, in an able paper read before the Royal Med. and Chir. Society, 1870, gave an analysis of 85 such, and clearly proved that in all cases we should attempt to save the limb, and adopt the ordinary treatment as for simple fractures of the patella. To this end the wound should be well washed with iodine water or carbolic acid lotion, and accurately closed by sutures, and inflammation ought to be subdued by the constant application of cold. If suppuration sets in free incisions should be made into the joint, and amputation resorted to only when the powers of the patient fail to repair the injured joint. Detached fragments of bone should, however, be removed at once.

Statistics of.

Out of the 85 cases collected by Poland, there were 20 deaths and 65 recoveries; in 31 of these there were more or less complete anchylosis of the joint; 20 recovered with movement, 4 were resected, and 5 amputated. The joint suppurated in 43 out of the 65 cases of recovery, and in all the fatal cases.

Case.

In March, 1883, I saw a man, æt. 56, who, after a compound comminuted fracture of the patella, had necrosis of about a quarter of the bone. He made a good recovery after the removal of the dead bone, and had almost complete movement of the joint. The case occurred in the practice of Mr. Wilson, of Grantham.

Fractures of the Leg.

Fractures of leg.

Statistics.

These are about twice as frequent as those of the thigh. At Guy's, 1090 cases were admitted in six years, against 541 of the thigh, and of these 202, or one fifth, were compound. Of the simple cases, not 1 per cent. died from all causes; and of the compound 27 per cent. succumbed.

Both bones generally broken.

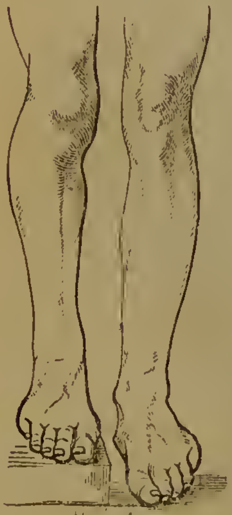
Both bones, as a rule, are fractured; the fibula alone being broken in about one case in six, and the tibia in about one in seven. Lonsdale's statistics indicate these points. These fractures are more commonly met with in adult than in child life.

In fractures of both bones, those of the upper half are usually the result of direct violence, fractures of the lower half of indirect, such as the twisting of the foot or leg from a fall or jump.

Fracture of tibia.

In fractures of the tibia alone the line of fracture is frequently transverse, and from this cause there is sometimes difficulty in making the diagnosis; the nearer the fracture to the knee the more transverse being the line. These fractures arise chiefly from direct violence. They may so unite as to leave no external trace of injury; indeed, they may be attended with so little displacement that the line of the bone is never broken. I have seen more than one patient walk upon the fractured limb directly after the accident, and in one case, the man went up a whole flight of stairs to his ward with but a slight limp. In another, under my care in 1874, a woman with a fractured tibia and fibula went about for a week. In a medico-legal point of view, these facts are important. When the shaft has been separated at its upper epiphysis, some arrest of growth may take place; and such a result is illustrated in Fig. 524.

Fig. 524.



Arrest of growth in shaft of right tibia (1 inch), with bowing of fibula, following injury to upper epiphysis two years before, in child, æt. 8.

Of fibula alone.

Fracture of the fibula is more common than that of the tibia, particularly in its lower third, and I believe in many examples of what are called bad sprains a fracture exists. Fracture in the upper two thirds, is usually caused by direct violence, but it may be by indirect, such as a wrench or twist of the ankle-joint; under such conditions the fracture will be oblique; in the lower third the violence is commonly indirect, such as a lateral twist or a forcible eversion of the foot. With pedal *in*version, the extremity of the tibia is mostly broken off. When with this fracture the foot is displaced *outward,* and its outer edge raised, the accident is known as "Pott's fracture" (Fig. 465), and under these circumstances the external ligament remains entire, the force being concentrated against the fibula from two to three inches above the malleolus; the internal ligament, however, is ruptured, or the inner malleolus is fractured. Displacement of the foot is not necessarily an attendant upon the fracture. It seems to be the result of some continuation of the primary fracturing force or of some additional force, such as that of an attempt to walk. In the indirect fracture, the line of fracture is probably oblique, the obliquity being determined by the direction of the force.

Pott's fracture.

Diagnosis.

Diagnosis.—In fracture of either of the leg-bones alone, the diagnosis may be somewhat difficult, and more particularly when no displacement is present. Crepitus may at times be made out by a forcible attempt to move or bend the lower fragments, or, by some sudden inversion or eversion of the foot, but the Surgeon should be careful in trying for this not to do harm. Local pain, however, caused by pressure with the thumb over the seat of fracture, and linear ecchymosis a few days after the accident are valuable helps to diagnosis in those as in all other kinds of fracture.

Local pain.

Linear ecchymosis.

Protracted or repeated examinations of the injured limb should always be avoided; they only add to the mischief.

Treatment.

Treatment.—In fractures of either of these bones, a natural splint is always found in the same bone, consequently any shortening or deformity rarely follows the accident. What the Surgeon has to do is, simply to apply some splint to ensure rest to the broken bone and to the muscles that move the foot—to the inside of the leg when the fibula is broken (Fig. 526), and to the outside when the tibia (Fig. 525); the splints should have a foot-piece. In fractures of the lower third of the fibula, the foot may be drawn inwards, the bandage being applied from without inwards, but in many instances nothing more is called for than absolute rest. In other cases, a thick pad is often of use opposite the seat of fracture. In no case should the bandage cover the fracture. After the lapse of a few days or at most a week, when all swelling with other evidence of local injury has subsided, the limb may with advantage be put up in some immovable apparatus.

Bandage not to cover fracture.

Fig. 525.

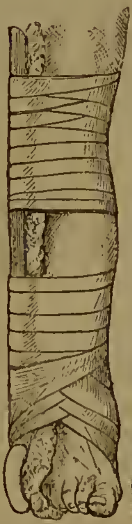
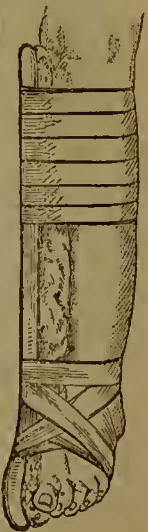


Fig. 526.



In Pott's fracture.

In cases of Pott's fracture, or dislocation of the foot outwards with fractured fibula, Pott used to place the patient on the affected side, with the injured limb flexed, fixing the leg upon an outside splint; an inner splint being likewise very usually applied. A better plan, however, is found in the posterior and two lateral splints, with a swing, as seen in Fig. 529, this mode of swinging the limb being a very good substitute for Salter's swing (Fig. 530).

Of both bones.

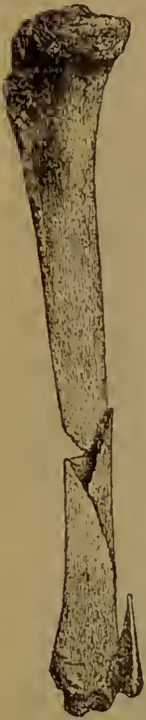
Fractures of both bones occur in every variety, and the most common is the transverse about three inches above the ankle, but every form of oblique, dentated, comminuted, and vertical fracture is met with (Fig. 472). When near the joints, the vertical into the joint is by no means rare. The Surgeon in his first examination of the fractured limb should, if possible, make out the line of obliquity of the fracture and the *tendency* one or other of the fragments may have to ride in any one direction, always observing the utmost gentleness in his manipulation.

Tendency.

V-shaped fracture.

When the tibia is broken at the junction of its middle and lower thirds, and the extremity of its upper fragment on its inner or subcutaneous surface presents a V-shape (Fig. 527), the Surgeon may expect to find a fissure in the lower fragment of bone, starting from the apex of the V and running in a spiral direction inwards, backwards, and outwards round the inner edge of bone, across its posterior surface towards the lower articular facet where the tibia and fibula articulate, the fissure then passing horizontally inwards across the lower articular facet of the tibia to the posterior border of the inner malleolus, to join the one on the posterior aspect of the bone, thereby cutting off a triangular fragment of the tibia at its lower extremity.

FIG. 527.



V-shaped fracture of tibia, with spiral fissures. Figure taken from a preparation of Gosselin's now in Dupuytren's museum.

This variety of fracture is generally produced by some sudden twist of the body when the foot is fixed.

It may be suspected during life, when joint complications are associated with the fracture. It was first described by M. Gosselin ('Gazette des Hôpitaux,' 1855).

Its serious nature.

When compound, it is generally of a serious nature, and, according to Gosselin, should be treated by amputation, Dr. R. M. Hodges, of America, goes so far as to say that by such a practice alone can the patient's life be saved ('Boston Med. and Surg. Journal,' Jan., 1877). Death usually takes place from pyæmia in cases that are left alone.

I am not disposed, however, to go so far in this direction, though I fully recognise the serious nature of these cases and believe that they claim the Surgeon's anxious attention.

Deformity.

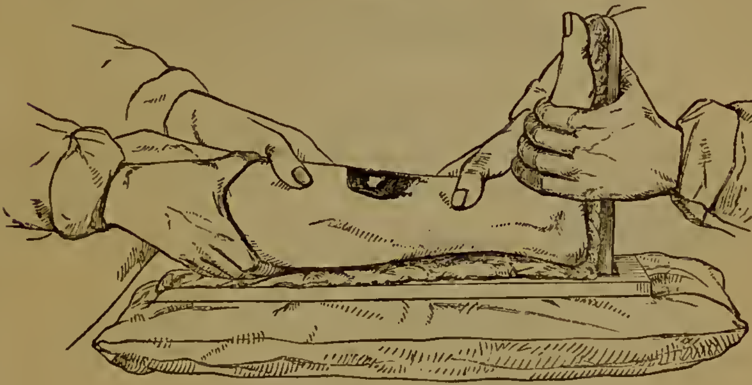
In transverse fractures there is rarely deformity. In the oblique, it is a common result—the upper extremity of the lower portion of bone projecting, as a rule—the lower fragment being rotated outwards from the great tendency the foot has towards eversion.

Symptoms.

The symptoms of fracture of the leg are too plain to be overlooked. The tibia being a superficial bone, any solution of continuity or deviation of the line of its spine is readily made out, the nature of the accident, loss of power, deformity, and crepitus, helping the diagnosis. In fractures near the joint, it may at times be difficult to make out whether the bone is fractured into the joint or not, and when a doubt exists, caution in prognosis and treatment should be observed. In fractures close to the ankle accompanied with displacement, dislocation may be roughly simulated, but the slightest care ought to detect the true nature of the case; the facility with which the displacement of the parts is rectified, the fact that the malleoli retain their normal relative position with the foot, and that the ankle-joint moves with facility, proves that the displacement is due to broken bones and not to dislocation of the joint. When the lower epiphysis of the tibia is displaced with the foot, there may be some difficulty in making out the true state of the case, but such an accident can only occur in children; it will appear as a transverse fracture, but with no sharp edge of bone as is usual in fracture, while replacement of the displaced fragments will not give rise to the ordinary crepitus of broken bone, but to a more subdued sensation.

Separation of epiphysis.

FIG. 528.



Process of setting a fracture of the leg.

When a wound complicates the case, the diagnosis is really made.

TREATMENT.—It is wise, in fracture of the leg, as of other bones, to "set" the fracture and to put the injured limb into the right position with good splints *as soon as possible.*

Treatment.

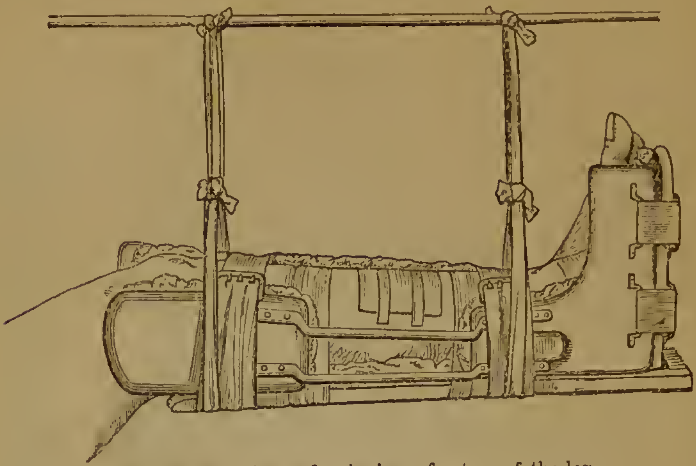
In a general way, for fractures of the lower two thirds of the bones, the best apparatus is a straight, flat, and not too broad, metal or wooden posterior splint (Fig. 528), with a rectangular footpiece and two broad lateral splints (Fig. 529), all being well padded and firmly fixed by broad strips of strapping, broad bands of inelastic webbing or bandages, the seat of fracture being left exposed, if possible, for observation. In Fig. 529, the whole apparatus is illustrated with an interrupted splint as for compound fracture. In reducing a fracture of the leg, the knee should be partially flexed or held by an assistant, the Surgeon manipulating the lower portion (Fig. 528).

During the putting up of the fracture, the limb must be kept extended and the broken bones maintained in position, it being a good plan to fix the foot and limb at first to the posterior splint, and subse-

Setting.

quently, to apply the lateral. The leg afterwards should be slung to a cradle by bandages (Fig. 529), or Salter's cradle may be used (Fig. 530). When any wound in the soft parts exists as in compound fracture, the corresponding lateral splint should be interrupted, as shown in Fig. 529.

FIG. 529.

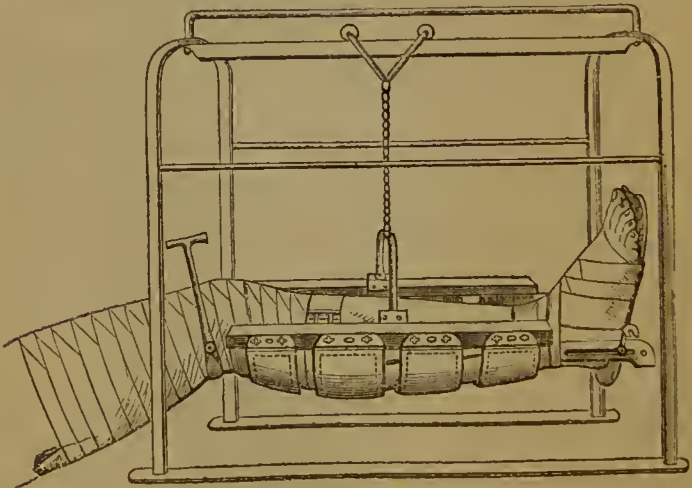


Apparatus for fixing and swinging a fracture of the leg.

Division of tendo Achillis.

When the fracture is close to the ankle-joint and any difficulty is experienced in keeping the broken bones in position from the spasmodic action of the tendo Achillis, the tendon should be divided. This simple operation at once permits the parts to be adjusted with admirable facility, and renders the retentive apparatus of real value, while it

FIG. 530.



MacIntyre's splint and Salter's swing.

allows natural processes of repair to go on uninterruptedly, the divided tendon and broken bones undergoing repair together.

When the fracture is near or into the knee, a posterior splint such as that of MacIntyre or Amesbury, may be employed; indeed, some employ this splint for most fractures of the leg (Fig. 530).

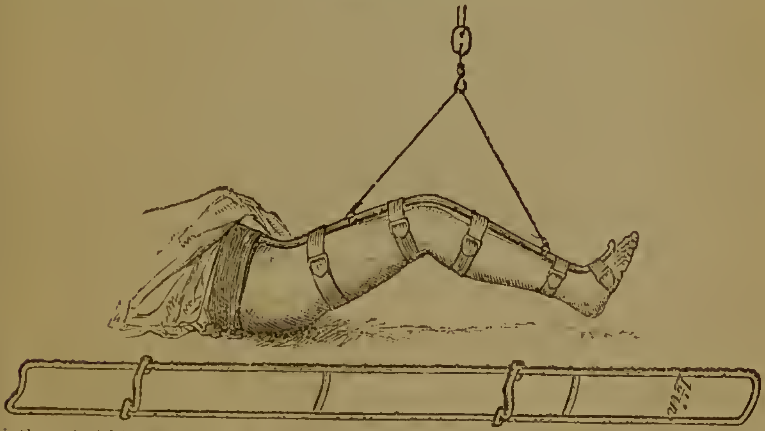
The sound limb as a guide.

In setting any fracture of the leg, the opposite limb should be exposed as a guide, and an inquiry made to prevent error as to the existence of any natural or acquired deformity. The foot should generally be placed at right angles with the leg, with the sole flat to the footpiece, care being observed that the heel does not fall and the lower fragment of bone consequently tilt upwards. The heel should also be well protected from pressure, and the foot covered and protected with cotton wool. "Take, therefore," writes Paget ('Lancet,' Feb. 27, 1869), "the footpiece of the splint as the guide for the position of the foot; and if you but see, in the management of fractures of the leg, that the foot of the patient and the footpiece of the back splint fairly correspond, it is hardly possible for the limb to fall into any defective method of repair. Correspondence between the axis of the foot and of the footpiece ensures that there shall be no rotation or version, either outwards or inwards. Then, again, you should be careful that the foot touches the foot-piece by the three balls of the sole—the ball of the heel, the ball of the great toe, and the ball of the little toe."

The anterior wire splint.

Dr. Shrimpton, of Paris, acting upon Dr. Nathan Smith's suggestion of an anterior wire splint, has applied it to fractures of the leg, with success. He employs a splint composed of double wires an inch and a half apart, held together by four transverse bars, and applied by means of straps to the front of the leg, as illustrated in Fig. 531 ('Lancet,' 1872), the limb being subsequently slung in a vertical direction, as Esmarch slings his patient's leg in disease of, or after operations upon, the ankle. After the limb has been kept in splints for about a month some immovable apparatus such as the flannel Bavarian (Fig. 476) may be substituted and the patient allowed to get up, moving about with crutches for another month. When there is little or no displacement

Fig. 531.



Nathan Smith's anterior wire suspension splint, with Dr. Shrimpton's modification of it below.

Immovable apparatus.

and little swelling, as soon as the immediate effects of the injury have passed away the immovable splint may be at once applied, that is, after the first week, the wants of the individual case being the only guide to its treatment. When the bones are comminuted and some loose portion has a tendency to ride or rise out of its position, the application of a pad, with sufficient local pressure to keep the parts in position, may be employed. When much effusion of blood or local action takes place, ice or cold lotion may be used as an application. Constitutional symptoms can be treated as they arise.

Compound fractures of the leg.

Compound fractures of the leg ought to be adjusted in the same way as the simple, care being taken to have an interruption in the splint corresponding to the wound (Fig. 529). When the wounds are extensive, the posterior hollow splint of MacIntyre, or any of its modifications, may be used with advantage.

When the bones are comminuted, the loose pieces should be removed, the wound cleaned and sealed with a pad saturated with blood, the compound tincture of benzoin or carbolic acid, as already described; at a later period of the case, when inflammation and suppuration take place about the seat of fracture, a free incision should be made down to the bone and any necrosed fragment removed. This operation gives relief to pain and expedites recovery.

When the injury to the soft parts is great and the large vessels or the joint are involved, amputation may be called for.

Statistics.

About one in every three cases of fracture of the leg is compound, the average mortality of the compound being also about one in three. Of those amputated, about 60 per cent. are fatal.

When amputation is called for, a primary operation, *i.e.* one performed during the first three days, is better than a later one.

Fractures of foot.

Fractures of the foot, commonly the result of some crushing force, are always serious on account of the injury the soft parts have sustained in common with the bones. When not so complicated, severe fractures of the bones of the foot as well as other bones will recover by rest and the application of cold lotions, &c.

Of the os calcis.

Fracture of the *os calcis* may occur by a fall from a height. It is seldom associated with any displacement, and undergoes excellent repair when natural processes are left to themselves. In exceptional cases, the broken fragment may be drawn up by the action of the gastrocnemii muscles, and, under such circumstances, the leg must be kept flexed and the foot extended to keep the fragments in position by some outside splint. Under these circumstances, however, the foot rarely recovers completely its natural use.

Of the astragalus.

Fractures of the *astragalus* also occur from some fall or violence and are often compound. I had a case some years ago, in which the upper surface of the bone with its head was split off and forced through the skin, and a second in which the bone was crushed into fragments and extruded from below the external malleolus. In the former the soft parts were so injured that amputation was performed; while in the latter, recovery took place by natural processes with a stiff but good limb.

Simple fracture may, however, occur, and I am disposed to think it is more common than is supposed, but the injury is difficult to diagnose, particularly when no displacement coexists. I have had occasion in two cases to remove from boys who had acute inflammation of the bone and joint, following an injury, the whole of the necrosed upper articular surface, with half the thickness of the astragalus, and in both good results followed. The piece I removed in both instances looked as if it had been fractured, and subsequently died. I have also recently (1878) removed from the inner aspect of the ankle of a man, the upper half of the astragalus that had been fractured six months previously, rotated and so displaced as to present its upper articular facet inwards. The case had been reported at a sister hospital as one of fracture of the tibia and fibula. The fractured bone had subsequently inflamed and died.

Compound fracture of the metatarsus and phalanges.

Compound fracture of the *metatarsal* and *phalangeal* bones should be treated on ordinary principles, the immediate dressing of the wounds with the compound tincture of benzoin to exclude all air and place the wound as much as possible under the condition of a subcutaneous one being absolutely indicated. When parts irreparably injured require to be taken away, no healthy structures ought to be sacrificed in order to perform a named operation.

COMPLICATED FRACTURES.

Extravasation of Blood.

Extravasation of blood in fractures.

Arterial blood.

Fractures are very often complicated with *extravasation of blood*, and then difficulties may be experienced in deciding whether the blood comes from an artery or a vein. In compound fracture, however, the difficulty of diagnosis is less than in the simple, since the florid character of the flowing blood, its pulsatile stream and capability of being arrested by pressure on its cardiac side, indicate its arterial source. In simple fractures, the difficulty is sometimes very great, particularly when the limb is distended with blood, and there is no pulsation in the swelling. When the vessels below the seat of injury pulsate naturally, the blood has probably a venous origin, but when pulsation is not felt, there is no reason to jump to the conclusion that arterial laceration has taken place, as the arteries may be simply pressed upon by the effused blood. When the swelling itself pulsates the diagnosis is simplified, for such pulsation generally means that a traumatic aneurism has formed, and some large artery been ruptured. In a clinical point of view, however, the question happily is not very material, as Surgeons are now tolerably well agreed as to the practice to be pursued.

Treatment of compound fracture, with rupture of an artery.

Cases.

Treatment.—In *compound fractures* the injured vessel should be tied or twisted, and the wound should be enlarged for this purpose when necessary; and even where such a practice is impossible, and from the nature of the fracture and condition of the soft parts it is probable that the limb may be saved, the main artery should be tied higher up, as fractures heal well with a diminished supply of blood. Years ago, when a student, I remember a case of Mr. Bransby Cooper, in which a compound fracture of the leg was complicated with a laceration of the femoral artery, and the artery was secured at the seat of injury. Repair went on as well in the fracture as in any case I ever witnessed. Mr. Bransby Cooper has also recorded in his 'Surgical Essays' a case of fracture of the femur where the femoral artery was ligatured for a ruptured popliteal artery, and recovery took place in six weeks.

In the autumn of 1873, a youth, æt. 18, came under my care with a compound fracture of the condyles of the humerus into the elbow-joint, and an injury to the brachial artery about its centre, sufficient to arrest all circulation through it. The wound into the joint was extensive, but as my dresser had sealed it well with lint soaked in the compound tincture of benzoin before I saw it, I thought it wise to leave the case to nature. The youth went on well without one bad symptom, and left the hospital with a movable joint. I am disposed to attribute the well-doing of this case to the fact, that the brachial artery was obstructed.

When, however, the condition of the limb at the seat of fracture is such as to forbid any hope of its recovery being entertained, primary amputation ought to be performed; if a doubt exists as to the probability of the limb being saved, the artery should be secured in or above the wound; and amputation should be performed as a secondary operation if the attempt fail to save the limb; the chances of a successful result in primary and secondary amputation being about equal.

Of simple fracture.

In *simple fracture*, when there is great effusion of blood and no pulsation in the swelling or vessels, the expectant treatment is the right one to adopt, the injured limb being kept at rest and elevated, and cold applied. When pulsation in the swelling is felt, and it is clear that arterial laceration has taken place, the same practice ought also primarily to be adopted, since every hospital Surgeon knows that these cases often do well under such treatment. I can recall several where it was as clear as symptoms could define that with fracture of the bones of the leg severe arterial laceration existed, and yet a good recovery ensued. To cut down at the seat of injury and secure the wounded artery is what no one at the present day advocates, although John Bell laid it down as a law that such a rule should be followed; but to do so above the seat of injury is one that commends itself to the Surgeon's attention, when it is clear that some treatment is requisite for the wounded vessel and that the fracture and parts around are progressing towards recovery. When gangrene of the limb threatens, it would be as unscientific as it is useless to adopt this practice; amputation, under such circumstances, being alone applicable.

Summary.

By way of summary it would appear that in *compound* fracture complicated with arterial hæmorrhage, the vessel ought to be secured if possible, in the wound, if not above it; and that primary or secondary amputation should only be resorted to when the local injury forbids any hope of a natural recovery being entertained.

In *simple fracture* the expectant treatment should, as a rule, be adopted. If from the progressive character of the hæmorrhage, interference is absolutely demanded, the artery should be secured above the fracture, and amputation had recourse to when gangrene of the limb follows. Pressure upon the afferent artery is a practice that also demands attention.

In exceptional cases, it may be expedient to cut down upon the wounded vessel at the seat of injury.

Fractures implicating Joints.

Fractures implicating joints.

These are generally grave injuries—though in *simple* fractures the worst effect that is usually to be looked for is some stiffness or anchylosis of the articulation. Yet this result is not constant, and a movable joint is not rarely secured. As a matter of precaution, however, the Surgeon should warn the patient of the risk, and be careful always to adjust the fracture and limb in the most useful position for a stiff joint. Such cases require very careful treatment, absolute immobility of the injured bone and articulation being essential points to be observed; the joint, if inflamed, must be treated upon ordinary principles. Passive movement of the joint should be commenced after the lapse of four or five weeks.

Compound fracture into joint.

Into knee.

Compound fractures into joints are among the most serious cases the Surgeon has to treat, and in the lower extremity generally require amputation. In the knee-joint, this practice is the best when the wound is great and fracture severe, though exceptional cases are on record in which excision has been employed. In less severe examples an attempt to save the member may be made, secondary amputation being performed when ill-success follows. The same rules are applicable in these cases as in wounds of joints, a simple fissure of bone adding but little to the danger; while severe comminution reduces the prospects of success to a minimum.

Ankle.

In compound fracture into the ankle-joint without displacement, no operation is usually called for, since good results are obtainable by conservative treatment.

Shoulder and elbow.

In compound fracture of the shoulder- and elbow-joints, amputation is rarely required unless the parts are irreparably crushed, or the patient is so old as to forbid any hopes of recovery being entertained. Yet in many cases excision should be undertaken, as it is wiser to excise the articulation at once with the view of securing movement, than to look for a recovery by natural processes where anchylosis must be expected, unless, indeed, the wound is small, the injury to the bones slight, and the patient young.

In compound fracture of the wrist, no operation is required as a general rule.

Summary.

By way of summary, compound fractures into joints should be regarded as cases of wounded joint, and treated accordingly, the amount of bone comminution and displacement having an important influence in determining the question and nature of operative interference, when such may be called for.

In large joints, where excision is inexpedient or dangerous, amputation must be had recourse to; in others, where excision is a sound operation, it should be preferred. In the ankle- or wrist-joint where the articular ends of the bones project, they should, except in young subjects, be removed.

Comminution of bones.

Comminution of bones is a complication that requires a few observations, although in *simple* fractures it does little more than render difficult the treatment of the case and increase the risk of some shortening or deformity. When, however, it is the result of a direct force from a "spent ball," or other projectile, the comminution may be very great, the bone also may be fissured and with the soft parts contused; the danger of the case under these circumstances being much aggravated, not only from the direct effect of the injury, but from the ostitis that is so liable to follow.

In compound fracture.

In *compound* fracture, bone comminution has, too, an important influence for harm; adding greatly to the risks and dangers of suppuration and diminishing the probabilities of a successful result; since each piece of bone often acts as an irritant and retards recovery, and the fragments too often subsequently die. It is always well, therefore, in these cases to remove the detached portions, and, when the extremities of the bones are rugged, to excise them. Large pieces of bone, however, that are held by their periosteal coverings, must not be interfered with. This splitting and comminution of bone is most frequently met with in gunshot wounds, the conoidal of the present day splintering far more than the round bullet of former times.

Projecting pieces of bone.

In all cases of compound fracture where difficulty is experienced in reducing the projecting ends of the broken bone, the best course is to remove them with a saw, particularly when they are sharp; comminuted fragments should also be taken away. When much bone has, however, been removed, the Surgeon should be careful not to separate the parts too much, for fear of want of union.

The subject of dislocation and fracture has been discussed in the chapter on dislocations.

Fracture from gunshot wounds will receive attention in the chapter devoted to gunshot injuries.

CHAPTER XXXII.

DISEASES OF THE JOINTS.

General remarks.

To assert that safe and scientific surgery can only be based on sound pathology may appear to be a somewhat trite observation; nevertheless, it is true, so true, indeed, that it cannot be impressed too forcibly on all who seek or profess to practise our profession. Moreover, it should be the aim of every Surgeon whose duty it is to practice and to teach, to demonstrate the truth of the assertion, and to establish his practice upon such a scientific basis. It is with this feeling that I now propose to consider the pathology of joint disease, to explain briefly the changes which the tissues undergo during inflammation, and the results to which those changes lead; setting aside, for the present, disputed points of pathology, and reserving for future consideration the subject of tumours involving joints.

On the primary seat of disease in joints.

Diseases of a joint generally commence as an acute or chronic inflammation of the bone or synovial membrane, although in the progress of any case, and particularly when disorganization of a joint has taken place, both tissues become affected; the extent to which either will be involved depending greatly upon the seat of the original disease. When it has begun in the synovial membrane, and gone on to produce disorganization of the joint, the bones in all probability will be found to be affected only on their articular facets; the deeper structures will not have been involved. When the bones are the original seat of the mischief, and the inflammatory process has spread from them to the synovial membrane, and disorganization of the joint taken place, the chief pathological changes will be seen in the osseous tissue, and either the whole or a part of the articular epiphysis, if not a portion of the shaft, will be involved in the disease. Under both circumstances, the cartilage covering the articular facets will have disappeared. When the bones are the primary seats of disease the cartilages are shed more rapidly, as the articular cartilages derive most, if not all, of their nourishment through the bones; and, as a consequence, any perversion of nutrition and inflammatory changes of this tissue at once show themselves in the cartilages.

Ulceration of cartilage not a primary disease.

Practically, there is no such thing as a primary disease of the articular cartilages, no such process as so-called ulceration of cartilage, independently of disease of other tissues. When the cartilages undergo a change it is always secondary to some affection either of the synovial membrane, when it is slow and partial in its action, or of the bone when it is rapid and complete. It should be remembered, however, that disease in the synovial membrane of a joint cannot exist for any time, or be of any severity without involving its ligaments, or the cellular tissue with which it is surrounded. Nor can inflammatory disease exist for any period in the articular extremity of a bone without more or less affecting its periosteal covering. It should be added, too, that there is good reason to believe that either bone or synovial disease may be started by a severe sprain or laceration of ligaments at their osseous or periosteal attachments.

On the term strumous disease of a joint.

Before proceeding to consider the changes the different tissues undergo from the inflammatory process it will be well to ask whether there is such a disease as strumous disease of a joint, strumous disease of the synovial membrane or bone?

If I were to answer this question according to custom, as indicated by the free application of the term to joint disease, I should unquestionably say that it was a common affection, for there are few chronic changes of a joint that are not so designated, and it is rare to meet in a delicate child with any chronic affection of a joint which is not regarded by some as a strumous disease. Indeed, from the constant use of the phrase, it might be thought that the term strumous disease had some definite meaning or conveyed some definite idea, that the affection so designated was of a special kind, could be recognised by special features, and possessed definite pathological characteristics. Yet it can hardly be said that such is practically the case; for if we look for the points of difference between the so-called strumous disease and the chronic inflammatory affections we shall fail to find them, since they are not clinically to be distinguished, nor practically to be separated. Indeed, I am more than satisfied that the so-called strumous disease of a joint is nothing more than a chronic inflammation of the bones or synovial membrane, or both; that the pathological changes in the affected tissues are such as are clearly traceable to a *low form* of inflammatory action, and that they differ in no single pathological point from the inflammatory changes found in other parts. It is true that such affections, being of a low type, differ from other inflammatory actions of a more healthy character, but that they are, nevertheless, inflammatory there can be no doubt. Practically, therefore, it would be well to expunge this term "strumous" in respect of joints from our vocabulary, as its use certainly misleads, by making the student believe that the term has a definite meaning when it has not, and by encouraging the idea that the disease to which

Practically it misleads.

it is applied has a constitutional more than a local origin, and is consequently incurable. Of this, however, I am sure, that so-called strumous disease of a joint is as curable and as amenable to treatment as any other chronic inflammatory disease. In saying this, however, I do not dispute the fact that, pathologically, we do at rare intervals find tubercular deposit in some of the tissues building up a joint, and particularly in the bone; but I must repeat what I wrote many years ago in my work on diseases of the joints, "that such preparations being so rare are to be regarded as pathological curiosities." They are discovered also accidentally, and cannot be clinically recognised by any characteristic features from other cases of chronic inflammation of the bone. It would be well, therefore, to give up the term in scientific discussion, or, if it be used at all, to use it in the same sense as the words tumours, rheumatism, and fever are now employed, as a broad general term that includes many affections and covers much ignorance.

A term to be given up.

Changes in the synovial membrane under inflammation.

With these general remarks I now pass on to consider the changes the different tissues entering into the formation of a joint undergo in the inflammatory process.

On the Pathological Changes which take place in the Synovial Membrane from Inflammation.

Change of function.

Change of structure.

Changes in acute inflammation of synovial membrane.

In a pathological point of view, inflammation of the synovial membrane may show itself in two distinct ways; firstly, in change of function, and secondly, in change of structure. The first change may take place without the second, but the change of structure necessarily includes an alteration in the function. The best examples of the first class of cases in which a change of function is the most prominent point, are seen in everyday practice in cases of so-called chronic or sub-acute synovitis, where excess of secretion in a joint is the main symptom, and in which this secretion may be re-absorbed and leave no trace of disease behind; whilst the best illustrations of the second class, in which change of structure is the main point of clinical as well as of pathological importance, are seen in the pulpy disease of the synovial membrane. Between the two great classes of cases, however, there are doubtless many links; for example, in acute synovitis we have change of structure even to more or less complete disorganization, and in chronic synovitis frequently repeated, we have change of structure such as gradually passes into the pulpy synovial disease. It would thus appear that in acute inflammation of the synovial membrane we have pathologically a series of changes that differ somewhat from those seen in chronic inflammation, and that while the acute form, it is true, passes into the chronic by imperceptible gradations, the two classes of cases are, nevertheless, very distinct. Acute inflammation of a synovial membrane in its early stage is pathologically represented by what my notes of cases clearly illustrate—a more or less minute injection of the capillary vessels, passing on to a velvety appearance of the synovial surface, a flocculent surface, or one covered with fine fringes of lymph, while in the more acute cases the synovial membrane may have disappeared by ulceration or sloughing, or have so softened down as to be destroyed on the slightest touch. In the former class of cases there will be clinically increase of secretion in the joint, severe local pain and heat with surgical fever; while in the latter, there will be acute suppuration, and the synovial membrane may show any one of the conditions already indicated; or they may have disappeared, pus and broken up membrane alone remaining to indicate the local severity of the action as well as the destructive nature of the affection.

In intermediate or less acute cases, other changes may be seen, but they are not less marked. In one, the notes of which are before me, there was visible to the eye a local patch of capillary injection, and beneath it could be made out a superficial granular change of structure in the cartilage. In another, an effusion of a firm fibrinous layer of lymph over the surface of the synovial membrane and articular cartilage showed itself, and this membrane could be raised from its bed and peeled off, not only off the synovial capsule, but also off the articular cartilage, and beneath this membrane fine radiating capillary vessels passing from the margin of the articular cartilage towards the centre were clearly visible. In this case, moreover, after a section was made through the spot of injected membrane and cartilage down to the bone, the swollen layer of membrane passing over the cartilage was clearly visible, as well as the granular degeneration of the cartilage beneath; and this membrane could be separated from its cartilaginous connection by means of needles. It occurred in a child, but it seems to me to be sufficient to prove by means of pathology what anatomy has hitherto failed to settle, viz., that a layer of membrane passes over the articular cartilage. I have seen these changes more than once.

Synovial membrane over cartilage involved.

The changes that take place in the synovial membrane in sub-acute and chronic synovitis remain to be noticed, and they are essentially of the same pathological character as those we have been just considering, though they differ in this great point, that the synovial membrane is not destroyed but becomes thickened in various degrees by the infiltration within its walls and upon its surface of inflammatory product, and this thickening may be so great that the synovial membrane may be represented by a tissue an inch in diameter. It will, however, be found only in cases in which repeated attacks of inflammation have taken place, and many layers of lymph have been deposited upon and in the affected tissue. The layers may not be deposited rapidly one after another by consecutive attacks of chronic inflammatory action, for they may be the result of disease which has spread over many years, but they will always represent an inflammatory action of a chronic nature which at uncertain intervals has attacked the joint, and on each occasion left behind it pathological evidence of its presence by an inflammatory infiltration. In delicate and so-called strumous subjects, the product will be soft and pulpy, and in the syphilitic firmer and fibrous.

In subacute and chronic inflammation.

Thickening of the synovial membrane.

It is with such changes as these that all cases of the gelatiniform or gelatinous disease of the synovial membrane, as well as the pulpy disease of Sir B. Brodie, are unquestionably to be classed. Both are of the same nature pathologically and clinically; at least, all my own investigations have led to this conclusion. I shall therefore employ the phrase "pulpy disease of the synovial membrane" to designate the changes which ensue in chronic inflammatory synovial disease. The term is short and as expressive as any other, besides being one with which the profession is familiar.

In syphilitic subjects.

Pulpy disease and gelatinous condition.

Changes in the articular cartilage from disease.

On the Pathological Changes which the Articular Cartilages undergo from Disease.

The most important point the practical Surgeon should recognise when considering the pathology of the articular cartilages has reference to the fact, that there is no primary disease of its structure, since pathological anatomy teaches us that all the changes found in it are secondary to some other affection, and in the generality of cases, to disease in the articular extremities of the bones. There is no such disease, therefore, as primary "ulceration of the cartilages," and, when the cartilages are diseased, they are so from the extension of mischief from the bone beneath, or from the synovial membrane around or upon them.

Errors in the pathology.

Much has been written about the cartilages under the idea that they were liable to special diseases; and much error has consequently crept into joint pathology, the authority of great names, such as Brodie, Key, and others, having helped to encourage this idea. Modern investigation, as carried out by Redfern, Goodsir, and others, has, however, corrected this erroneous notion, and an improved pathology has clearly shown that the diseases of the cartilages are secondary to diseases of other tissues.

Some years ago, when describing the results of my own investigations, I divided these affections into the *fatty*, the *fibrous*, and the *granular* degenerations, and nothing that has been observed since has led me to doubt the accuracy of this classification; indeed, additional experience has confirmed its truth. I am not about to enter, however, into a minute description of the different changes, for they can be read elsewhere; but it may suffice for my present purpose to remind the reader that the *fatty degeneration* of the articular cartilages is found in joints that have been deprived of their natural functions from any cause—from non-use in the majority of cases, but in many from bad nutrition—that it is found in common with the same change in the bones or other tissues. This fatty degeneration can be recognised with tolerable facility by the naked eye, for the cartilage so affected, instead of possessing its natural white pearly aspect, will appear somewhat transparent, with an undulating, unequal, although smooth, surface. It will, when cut, feel softer than usual, and may be three or four times its natural thickness. At times it may even be "pulped" by firm pressure with the finger, and be separated from the bone with more than usual facility. Microscopically also it will present characteristic features. The natural cartilage-corpuscles will have become changed into fat- and granule-cells in various degrees, and the hyaline matrix will be filled with cavities varying from the healthy standard to large spaces. These spaces, moreover, will be filled with the elements of fatty degeneration, into which the healthy corpuscles will have changed. This fatty degeneration takes place in most joints that have not been used, but rarely from disease of the joint itself. When, however, a joint so changed becomes the subject of inflammation, disorganization of the articulation rapidly follows, for such a degenerated tissue has no power of resisting disease, and disappears when attacked by it rapidly.

Fatty degeneration of articular cartilage.

Character under microscope.

The fibrous degeneration of the articular cartilage is a disease of a

Fibrous degeneration of articular cartilage.

Appearance under microscope.

peculiar character. I believe it to be associated with only one disease of a joint, which is "osteo-arthritis." It is very gradual in its progress and not characterised by any definite symptoms. It can be recognised pathologically in its earliest stage by the loss of the natural glistening aspect of the cartilage of a joint, the smooth surface of which disappears and looks rough. Small fissures involving more or less of its thickness next appear, which sometimes extend down to the bone, and, as a rule, are thicker in the centre; they occasionally radiate outwards. The cartilage seems gradually to become thin, and after a time to disappear, exposing the articular surface of the bone, which probably will have undergone the calcareous degeneration. Microscopically, the principal change that is seen in this disease is the gradual alteration of the hyaline structure into fibre. The cartilage-corpuscles at the first will be found interspersed between these fibres, but, at a later date, to have changed into granules. At the last stage nothing but fibres may be found, and when this condition exists, the total and rapid disappearance of the structure will not be far distant.

Granular degeneration of articular cartilage.

The granular degeneration of the articular cartilage is the most important affection of this tissue. It is the one most commonly found in joint affection, and seems to be the direct consequence of a perverted nutrition in the bone or synovial membrane from disease of these structures. Though of a simple nature, it shows itself in many ways, and, without microscopical investigation, must have appeared unintelligible. In its different forms, it has doubtless led good observers to describe it as an ulceration of cartilage, for, under certain conditions, the cartilage presents a worm-eaten excavated appearance not unlike that which ulceration might produce.

Characters of granular degeneration.

The disease is essentially a granular degeneration, first of the natural cartilage-cells embedded in the hyaline matrix, and secondly, of the hyaline matrix itself. Let a cartilage-cell undergo this granular degeneration, and the granules by accumulation and multiplication form a cavity in the hyaline matrix. Let this cavity burst on the surface of the cartilage into the joint, and an excavation is formed which can be seen by the naked eye, and a so-called ulcer is produced. Let this change take place towards the margin of the articular cartilage, and we find an explanation of Mr. Key's observations upon so-called ulceration of this tissue in certain forms of inflammation of the synovial membrane of the joint. Let this change take place near the bones as a result of disease in their articular ends, and we find an explanation of the general condition of the cartilages in the bulk of joint diseases; for, when the bones entering into the formation of a joint are so affected as to interfere with the nutrition of the articular cartilages, the cartilage may either present the worm-eaten appearance all over or in part, or it may have been shed from its bony attachment, when it will be found to be lying upon the bone as a foreign body in the joint. In an early stage of disease, this granular degeneration may only be detected by a microscopical examination, although when it follows upon disease of the bone the cartilage will always be found to peel from off its articular facet with unusual facility.

In synovitis also, the surface of the cartilage in contact with the inflamed membrane will be found similarly involved. Should the disease be local, as is at times seen in cases of injury to an internal ligament such as the ligamentum teres, the change in the cartilage will be local only, but when general, the whole surface of the cartilage may be involved. In acute disease, acute degeneration follows, as is evidenced by daily practice.

Changes in the bones under inflammation.

On the Pathological Changes in the Bones the Result of Inflammation.

General remarks.

Inflammation of the articular extremities of a bone is a very common disease, and is probably the most common we have to deal with in connection with joints, for it would appear to be the cause of most if not all of those cases of disease of the articulations which we find in children, and have been described as strumous or scrofulous disease of a joint. Some years ago, when writing on this subject, I stated that "I cannot for one moment doubt that the majority of the cases which are described by Surgeons as strumous or scrofulous disease of a joint of the articular extremities of the bones depend upon a chronic inflammation in the bone," and all the experience I have gained since has tended to confirm me in this opinion. I believed then, as I believe now, that the disease in its origin and progress is inflammatory, and that it is as curable as any other local affection. It is important to bear this invariably in mind when examining or treating a case of disease of a joint, particularly when it is found in a so-called strumous or cachectic subject; for if we regard the disease as a constitutional one, we are apt to think it ought to be treated on general principles, and to neglect the local means by which alone a good recovery can be secured.

Let us now inquire into the changes that the bone undergoes during this inflammatory or wrongly called strumous affection.

Expansion of the articular extremity.

Characters.

The most striking is probably the earliest, which is the expansion of the articular extremity, and in some cases this will be very great, and generally uniform. The articular extremity of the affected bone, or the epiphyses of all the bones entering into the formation of the joint, will appear to be rounded and generally enlarged. Upon making a section of a bone thus affected it will be found softer than natural; indeed, it may be so soft as to allow a knife to divide it, or even to break or crush it on firm pressure. To the eye the section will appear more vascular than natural, the cancellated portions more cancellated, the cells enlarged, and the bony septa radiating from the shaft in a broad, palm-like fashion. The cells will also be found filled with a pinkish serum.

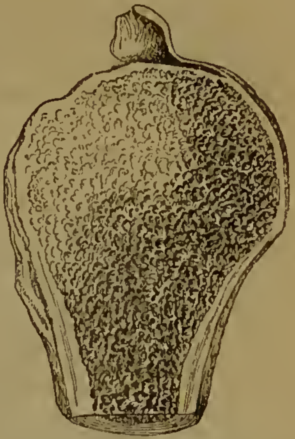
Bone may become dense and indurated.

May suppurate and die.

Extension into joint causing joint disease.

If the disease continue, and the inflammation be of a healthy type, parts of the bone will appear denser and more indurated than the remainder; its cancelli will be filled with inflammatory products which have organised, and the bone will appear on section as a dense and apparently bloodless mass surrounded by other vascular cancellated tissue. Should the inflammation be of an unhealthy character, diffused suppuration within the bone will take place, and death of the bone, wholly or in part, follow. Under these circumstances, the disease will probably have become a genuine joint affection, and have extended to the synovial membrane of the joint, and set up disease within its substance. This extension of disease will show itself by effusion within the joint, by pulpy thickening of the synovial membrane, and of the cellular tissue around the articulation. Up to this point the disease has been local, involving only the articular extremities of the bones, and has not attacked the proper joint structures, and appears also to be perfectly curable. But at this stage of the disease the articular cartilages will have become affected; for when the inflammatory action has continued for any period, and not shown any indications of subsidence, but, on the contrary, has either assumed an unhealthy character, or interfered with the nutrition of the articular lamella of bone upon which the cartilages rest, the articular cartilage to a certainty will undergo a granular degeneration upon the surface in apposition with the bone, become loosened from its attachment, and be thrown off or shed (Fig. 532); or it may degenerate in patches, and present to the eye an irregular excavated surface. If the disease be chronic the cartilage will degenerate slowly, and be as slowly loosened from its osseous base, when it may readily be lifted off the bone by any instrument. If the disease be more rapid the cartilage will likewise be shed more rapidly, raised as a blister off the bone, or found lying upon it as a foreign body; under the microscope, it will appear to have undergone the granular degeneration.

Fig. 532.

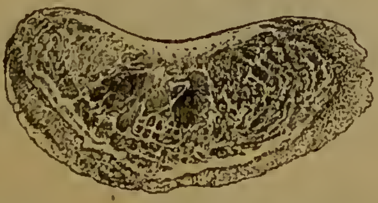


Drawing (G. M. 3030^{6}), made to show the shedding of the articular.cartilage in ostitis.

When the disease is acute, the cartilage may disappear altogether, having been shed from its osseous base, and become rapidly degenerated.

The articulating surface of the bone during this time may appear in some cases as in inflammation, only extra-vascular; in others, it may be rough, or, so-called, ulcerating; while in a third class the articulating facets will have been shed wholly or in part. In a still worse class, pieces of necrosed bone involving more or less of the articular extremity will be seen, while in the worst, an abscess will have made its way into the joint from the diseased articular extremity. In all these conditions the cartilages will have disappeared and the joint become disorganized. These pathological remarks are applic-

Fig. 532a.



Transverse section of the humerus above the condyles, showing new bone deposited beneath periosteum, undergoing rarefaction and thus simulating true bone structure. Taken from a specimen of Mr. J. Poland's.

Disorganisation of the joint.

able to every articulation, to the hip as much as to the knee and to the shoulder as to the elbow.

In all chronic cases of ostitis there will be found more or less deposit upon the bone beneath the periosteum, and some good Surgeons believe that it is by such deposit that the clinical symptoms of enlargement of bone are solely to be explained. My friend Mr. C. Symonds has ably supported this view ('Brit. Med. Journ.,' Dec. 8, 1883).

The drawing above shows how subperiosteal bony formations subsequently rarify, so as to simulate true bony enlargement (Fig. 532A), the cancellous appearance being due to the widening of the canals in the compact tissue through absorption of the bony walls.

Clinical Symptoms associated with these Pathological Changes.

External appearances in synovitis.

The symptoms by which these pathological changes which have been described can be recognised vary according to the formation and surroundings of each joint, but in their general character they are the same. *Any inflammation of the synovial membrane*, of whatever kind, always shows itself within a few hours or days of its origin by effusion, and consequently by distension of the articulation, while in the knee, ankle, elbow, wrist, shoulder, and other joints, this clinical condition makes itself manifest in a way which cannot be misinterpreted. The synovial sac becomes enlarged and distended by the effusion, so that it bulges between the bones, and gives an outline to the joint unlike that furnished by any other condition. In the hip-joint similar changes take place, but they are not quite so palpable, though they can be made out by careful examination, and particularly by a comparison of the affected with the sound side, a point of practice which should never be omitted in the examination of any injured or diseased joint; the soft parts in front of the joint will be more prominent and full; pain will be produced by gentle pressure made upon the part, particularly behind the great trochanter, where a soft swelling, which will be manifest to the eye, will also exist in lieu of the natural depression. Even fluctuation may be detected through the joint on careful palpation. At any rate, to the eye and hand there will be clearly some extra fulness of the soft parts, sufficient to lead a Surgeon to suspect the true nature of the disease.

In disease of the articular ends of the bones.

In disease of the articular extremities of the bones a different clinical condition will be present. At the commencement of the disease, and sometimes for a lengthened period, which varies in each case, an aching of the part is the only local symptom. This aching may be of greater or less intensity, and depends much on the severity of the disease. It is too often regarded as "growing pains" or rheumatism. What I wish now to note is, that local pain is the first clinical symptom, and not effusion, and that there is no enlargement of the affected joint. As the disease progresses, however, an enlargement may be detected, which in the hip can be made out by manipulation; whereas in the knee or other joints it may be visible to the eye. It will show itself as an apparent enlargement of the bone, a thickening or expansion of the osseous and probably periosteal structure unlike that existing in synovial disease, there will be no fluctuation, no soft yielding of the parts, but clearly a thickening of the osseous structure, of the articular extremity of the bone, while the soft parts covering in the enlarged bone are quite natural. With this aching of the part, there may also be increase of heat as an early symptom, yet this symptom is not constant, although it is fairly uniformly so; it may, however, be intermittent. As a rule it shows itself as a general periodical flushing of the part.

Manipulative indication in chronic synovitis.

In chronic synovitis which leads to joint changes, the joint may probably be gently moved without exciting pain or spasm of the muscles that move the articulation. Pressure upon the part with the fingers will probably excite it, although moderate pressure of one bone against the other may be made without giving rise to any indication of distress.

In diseases of bone ends.

Inter-articular pressure.

In diseases of the bone entering into the formation of the joint, these clinical conditions do not all exist. The joint may be moved quietly, without exciting pain, but the attempt will, as a rule, excite spasm of one or more of the groups of muscles which move the articulation. Moderate manipulation also will be well borne. Firm pressure upon the bone so as to bring the two articular surfaces in contact will always excite pain, not the pressure produced by a jar, such as in the hip is caused by a sudden blow upon the foot or trochanter, for such a mode of investigation must be looked upon as rough and somewhat uncertain; indeed, it is almost sure to excite a start in the patient and an expression of pain, but the pressure which is produced by a steady force applied by the hand to the trochanter towards the pelvis, or through the foot to the articular extremities of the bones; a pressure which, in synovial disease, rarely, if ever, gives rise to pain, but in osteal disease invariably excites it.

These symptoms in the two classes of cases appear clearly to indicate the two distinct affections in their early stage. They apply to all articulations, and may be thus summarised :

Summary.

In synovial disease, swelling is the earliest clinical symptom, with more or less fluctuation, each joint showing this in its own way. As a rule, this swelling is unattended with much pain. Pressure on the joint causes pain, although gentle movement may be made without increasing it or exciting spasm of the muscles which surround the joint. Inter-articular pressure can generally be tolerated.

Symptoms in articular ostitis.

In articular ostitis, pain is the earliest and most constant symptom—pain of an aching character varying in intensity and generally increased by firm local pressure. There will be no visible enlargement of the part for some weeks or months, and no fluctuation. Gentle movement, generally, excites spasm of muscles about the joint, and inter-articular pressure always increases this and causes pain. Increased heat also exists about the parts and is of an intermittent character.

DISEASES OF SPECIAL JOINTS.

Diseases of the Hip-joint.

On diseases of the hip-joint.

Authors have hitherto led their readers to look upon diseases of the hip-joint as a special or peculiar affection, and to regard it pathologically and clinically as distinct from diseases of the other joints.

General remarks.

Such, however, is not the case, for diseases of the hip-joint differ in no single pathological point from those of any other articulation.

It has also with too much confidence been described as a "strumous disease," as if all diseases of the hip-joint or of any joint were generally of this nature, or found in subjects only of a strumous diathesis; as if all had a constitutional and not a local origin.

Not strictly a constitutional disease.

Hip-joint disease is a local disease, and is mostly set up by local causes. It is, moreover, as amenable to local treatment as any other affection. "It occurs very frequently in strumous children," says Mr. Holmes, "a circumstance which has led to its being denominated 'strumous,' but it seems to have no necessary connection with struma, unless so wide a signification be assigned to that somewhat vague term as would render the designation itself unmeaning. If by struma be meant a state of the system which renders the subject of it prone to the deposit of tubercle in the viscera, I think that there is good reason for asserting that morbus coxarius often attacks children who are not strumous—*i. e.* who do not display any such tendency to the deposit of tubercle—and therefore that no decisive proof of any strumous tendency is afforded by the presence of the affection. If, on the contrary, struma be defined as that condition of the system which disposes its subjects to the development of low inflammations of various kinds, then it is difficult to see what is the significance of the designation." It would, therefore, be well to discard the erroneous notion that hip disease has its origin in a constitutional cause, for till that is effected the local treatment is likely to be disregarded or looked upon as of secondary importance, whereas all who have much experience in the treatment of these cases will admit that local treatment cannot be made too prominent a feature.

Is a local affection.

It should therefore be looked upon clinically as a local affection and one to be treated by local means, such constitutional treatment being employed as the general condition of the patient may appear to warrant, the same principles of practice being applicable in these cases as have been found of value in other joint affections.

A frequent disease. Statistics.

Hip disease, unfortunately, is a very common affection, and my own statistics inform me that it forms about 30 per cent. of the joint cases admitted into a metropolitan hospital. It is also an affection of child life, for out of 360 cases of which I have notes, 62 per cent., or nearly two thirds, occurred in children under ten years of age, and four fifths in patients under twenty, that is, it occurred during the period of the growth and development of the bone, and not during that of its full maturity. This point will be seen on reference to the following table:—

Ages.

Table showing the ages at which hip disease commenced.

Four years and under	126 cases	223 cases, or 61·9 per cent.
Between 6 and 10 years of age	97 ,,	
,, 11 ,, 20 ,,	86 ,,	or 23·8 per cent.
,, 21 ,, 30 ,,	27 ,,	or 7·5 ,,
,, 31 ,, 40 ,,	13 ,,	or 3·6 ,,
Above 40 years of age	11 ,,	or 3 ,,

230 of these cases were collected by me when acting as registrar at

Guy's from 1853 to 1861; and 130 are from the notes of cases which have been under my own care.

Sex.

It is found in the male and female subject in equal proportions, but appears to attack the left more frequently than the right limb, 60 per cent. of my cases having occurred on the left, and 40 on the right side, and this proportion is very similar to that published by Mr. Lonsdale in the 'Lancet' for September 8th, 1855, where out of 112 cases of deformity of the hip, 65 were of the left and 47 of the right side.

Pathology of hip disease.

Pathology of Hip Disease.—It has been already stated that in a pathological point of view, hip disease differs in no respect from that of other joints, and is not a strumous affection although it may occur in strumous subjects. It may also be repeated, that it is a very rare thing to find strumous or tubercular matter in a diseased hip-joint. Excluding new growths, disease of the hip consequently means, inflammation of the bones or soft parts entering into the articulation, and in at least two thirds of the cases inflammation and necrosis of bone.

On the seat of the disease. General remarks.

In the pathology of joints, few points probably have been more disputed than the seat of the disease in hip-joint affection; and I believe the difficulty has been entirely raised on the mistaken notion, that the nature of the affection was different from that of other joint diseases. We have never heard much importance placed upon the point in diseases of the knee, shoulder, or other joints. The question as to the origin or not of disease of the knee in the crucial ligaments, or of disease of the shoulder in the long tendon of the biceps has never been very warmly discussed. And yet we find men gravely discussing the question as to the origin of hip disease in the ligamentum teres. My late much respected teacher, Mr. Aston Key, laid great stress on this point, and believed that it was from that ligament and its attachments that disease of the hip-joint generally proceeded. Pathology has, however, made great advances since those days, and we now know that disease in a joint (hip or other) may have its origin in the bones which form the joint, or, in the soft parts or ligaments that hold them together. Experience, moreover, has taught us that we may have an acute inflammation of the synovial membrane rapidly going on to complete disorganization of the ligaments, cartilages, and soft parts of the joints, and even causing death of the bones entering into its formation. The inflammation may be so acute as to render it difficult at the post-mortem examination to read the pathological facts correctly, for when such changes as these take place, it is fairly open to question whether the inflammation originated in the synovial membrane and spread to the bones, cartilages, and ligaments causing their destruction; or, whether it began in an osseous centre and extended to the joint. This difficulty is experienced when the disease has been so severe as to cause a division of the pelvic bones into their original segments, or a separation of the epiphysis of bone forming the head of the femur from its normal attachment to the neck.

Often difficult to determine.

Indication as to the probable origin.

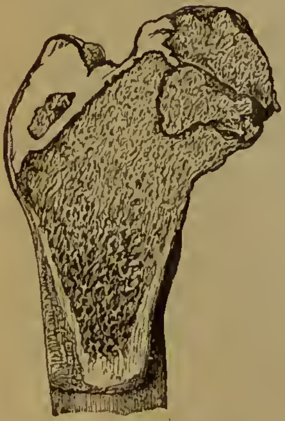
When the bones of the joint are equally involved in acute disease, it is probable that the mischief began in the synovial membrane and spread to the bone. But when we find one bone more diseased than another, *e.g.* the femur than the acetabulum, or *vice versâ*, it is probable that acute inflammation originated in it and spread to the soft parts. These points, however, are to be looked upon as only feeble indications and not as definite guides, upon which an opinion may be formed. In chronic disease of the hip-joint, the question as to the seat of the original disease is not so easily answered, and yet, from what I have observed clinically and pathologically the question is not one impossible to answer. When a joint is disorganized, its ligaments and cartilages gone, and the articular surfaces of the bone exposed, or perhaps diseased, there may be some difficulty in deciding as to the particular tissue in which the inflammation originated; but when a section of the bone is made—*e. g.* the head of a femur, or the head of a tibia—and a cavity, a sequestrum, or a suppurating bone is found communicating with the joint, probabilities certainly point to the bone as being the original seat of the disease. But it may be asserted that in such instances no one doubts the cause of the joint disease, since the pathological conditions clearly prove it; yet the clinical histories of such cases differ in no single point from those of others in which, perhaps, the same very marked evidence of disease is not to be seen, that is, if the joint be examined on its surface only. Indeed to examine a pathological specimen of a bone or of a diseased joint, it is absolutely necessary to make a vertical section through the bone; since to look at it from the joint surface is most fallacious, and an opinion formed from the appearance thus acquired is too likely to be erroneous.

Sequestrum of bone as an indication.

Origin of the disease to be determined by vertical section of bone.

If we make, then, a section of the bone in chronic disease of the joint, we shall find in a large number of cases, specially in the young, hyperæmia of its articular extremity and condensation, if not suppuration or necrosis from chronic inflammatory action (Fig. 533); in fact, we shall find marked evidence of articular ostitis in one of its stages, for, doubtless, during young life this is the most common form of disease which precedes joint mischief, and from which joint disease proceeds. This opinion is also corroborated by the fact that, in our museums, almost every specimen of chronic joint disease reveals advanced bone mischief extending beyond the surface, and generally involving more or less of the articular ends of the bone which enter into the formation of the joint. In our Guy's museum, this point is very strongly displayed, and on looking over other museums and copious notes of joint cases, the same truth is apparent.

FIG. 533.

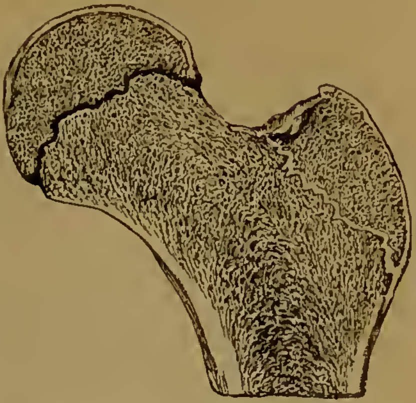


Necrosis of the head of the femur, with sequestrum in its neck. Prep. 1318⁵, Guy's Mus.

Generally an inflammatory action in bone and extending to joint, &c.

At times, however, the disease may primarily commence in the epiphysial cartilage situated between the head of the femur and its neck, the epiphysis as a consequence being thrown off (Fig. 534). This pathological observation must be looked upon as of great clinical importance, for if the majority of cases of joint disease is to be attributed to the extension of an iuflammatroy action from the articular extremity of a bone to the other tissues, it becomes a question of urgency to recognise the disease of the bone in its early stage, in order to prevent its progress to the tissues upon which the integrity of the joint itself depends; and clinically, there is good reason to believe that such can frequently be done. In the hip-joint it may be difficult, possibly more difficult than it is in disease of other articulations that are not so well covered in with soft parts, such as the knee; but it can be made out with care and discrimination even in the hip. And here it may be well to consider the clinical features upon which our diagnosis should be determined.

Fig. 534.



Separation of epiphysis forming the head of femur. Guy's Mus. Prep. 1315⁵⁰.

Diagnosis.

On the diagnosis of hip disease.

The necessity of making a correct and early diagnosis of hip disease scarcely requires illustration, did not daily experience indicate that it is not sufficiently recognised. The early symptoms of the affection, consequently, are important.

Symptoms of hip disease.

When a child after injury to the hip has joint pain and possibly limps, and these symptoms persist after all external evidence of injury has passed away, there is some reason to suspect the presence of joint mischief. When this pain is increased by inter-articular pressure, by means either of the hand applied over the trochanter or by the patient standing or walking, the suspicion should be strengthened. When swelling of the parts can be made out, and some bulging of the synovial membrane, as shown by a fulness behind the trochanter and in the groin, is found to exist combined with tenderness, synovial inflammation is rendered probable; and when persistent pain without effusion is the more prominent symptom, aggravated by firm inter-articular pressure, bone mischief is indicated. When these symptoms appear after some fever or illness, or, indeed, without any such cause, they are of no less importance, although, probably, they are more liable to be overlooked.

Pain as a symptom.

Limping.

Spasm of muscles.

As a clinical point of primary importance, all joint pain claims attention, and particularly in hip-joint cases, and when this is referred to the knee, the Surgeon must not be misled. *Limping* of any kind always indicates something wrong—probably very wrong—more particularly when combined with joint pain, aggravated by inter-articular pressure. *Spasm of the muscles around the joint* is a symptom of great significance and a means that nature adopts to ensure immobility of the affected articulation; in some cases it will be so severe as to forbid all movement, but in others it is less marked; at one time it will be confined to one group of muscles such as the flexors, when the position of the limb will be determined, while at others, the rotators or abductors will be affected; but whenever it is met with, there is probably some affection of the joint itself, or of the bones that enter into its formation. When doubt exists as to muscular spasm being the cause of joint immobility, an anæsthetic should be used, as all spasm ceases under its influence, and the head of the bone, by manipulation, rotates with more or less facility and smoothness, according to the amount of joint mischief that is present.

Position of Limb as a means of Diagnosis.

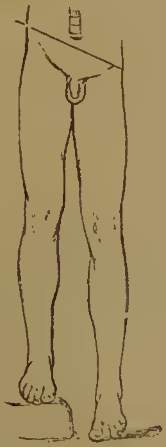
In the diagnosis or treatment of hip disease there is no point which deserves closer attention than the position of the limb, and I am disposed to think it has not received that attention, since experience has proved that most of the cases of deformity met with after a natural cure of the disease are due to a want of appreciation of its importance.

Position of limb in early hip disease.

In one case the limb will appear elongated, but on measurement no real lengthening will be detected, the apparent elongation being due to the tilting upwards of the pelvis on the *sound* side, from the patient either naturally throwing all the weight of the body on that side to take off pressure from the affected one, or, from muscular spasm causing abduction of the limbs (Figs. 535, 535A). In another case the pelvis on the affected side will be drawn up, and tilted slightly backwards, the thigh becoming adducted and more or less flexed upon the pelvis (Figs. 536 and 536A), or in some cases rotated outwards from the spasmodic contraction of the muscles that move the hip.

Effects of *ab*duction of femur.

FIG. 535.



Apparent *elongation* of the left lower extremity in hip disease on the left side, due to *ab*duction of the limb and the necessary tilting upwards of the pelvis on the sound side to allow the abducted limb being brought into a line with the body.

FIG. 535A.

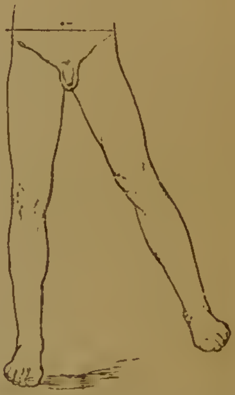


Fig. 535A shows the *ab*ducted position of the diseased left limb when the pelvis has been brought into its natural position at right angles to the spine.

In advanced disease.

In other and more advanced cases, genuine shortening of the limb may take place from either real loss of substance in the head or neck of the bone, or, in exceptional cases, from dislocation of the head of the femur upwards and backwards (ilio-ischiatic); and, in rarer examples, the neck and shaft of the femur may be separated and displaced upwards and backwards, the epiphysial head of the bone being left in the acetabulum. This probably occurred in the case from which Figs. 537-8 were taken.

Spurious lordosis.

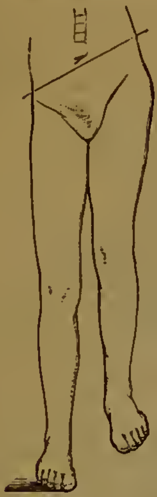
Where the joint is flexed, some spinal deformity (lordosis) will exist when the patient stands or lies, but this apparent spinal curve will, however, even in the worst cases, at once disappear when the patient is placed on his back and the limb raised (Figs. 539, 540), or when he stands with the leg flexed (Fig. 542). Apparent elongation of the limb under all circumstances means its *ab*duction; shortening of the limb implies *ad*duction; flexion gives rise to *lordosis*. These conditions follow necessarily any attempt of the patient to bring the sole of the malplaced limb down to the ground.

Effects of *ad*duction of femur.

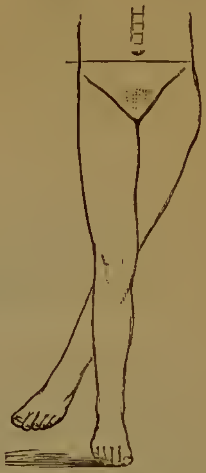
Fig. 536.

Fig. 536a.

Apparent shortening of limb in hip disease caused by adduction.



Position of patient when standing with disease of the left hip joint and an *ad*ducted limb. The pelvis is tilted up in the affected side and the limb thereby apparently shortened.



Position of the adducted limb when the pelvis is brought straight.

Displacement of femur.

Fig. 537.

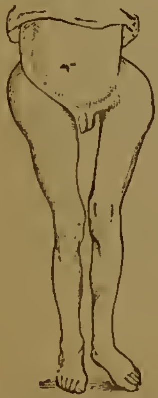
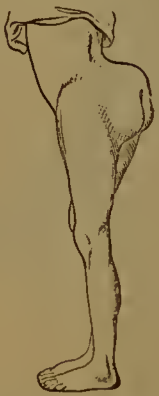


Fig. 538.



Displacement of femur, taken from William D—, æt. 9, following disease of five years' standing. There was some movement in the joints.

Flattening of the nates.

Lordosis effects of flexion.

Flattening of the nates, as seen in hip disease, is due to a wasting of the glutei muscles from want of use, this symptom becoming more marked when the thigh is slightly flexed, the trochanter rotated outwards and the foot inwards.

FIG. 539.

FIG. 540.

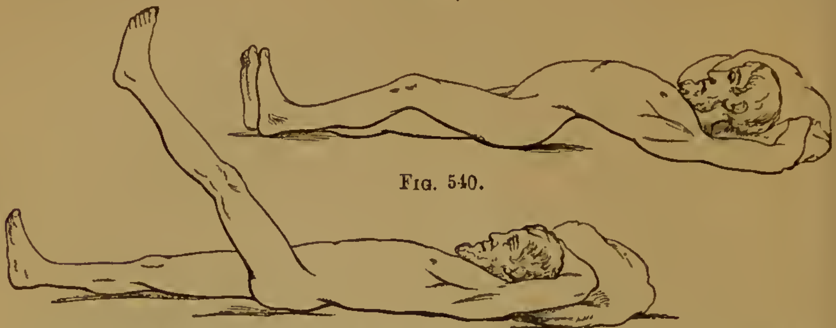


Fig. 539.—Lordosis of spine, as seen with patient the subject of hip disease in recumbent position with femur flexed at angle of 130 degrees.

Fig. 540.—Lordosis effaced by elevating the flexed limb.

When attended with suppuration.

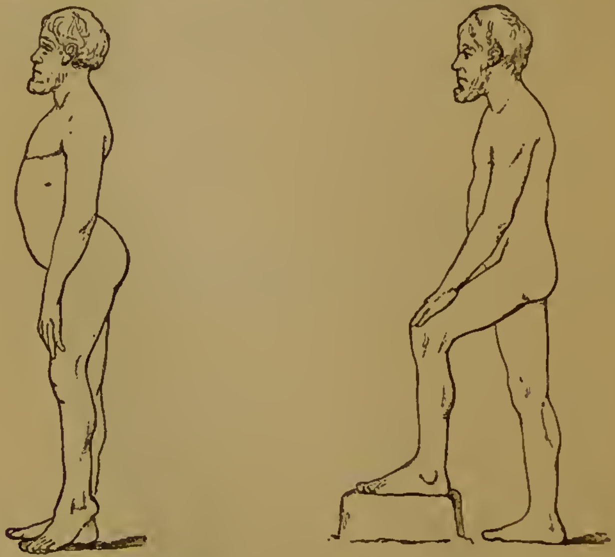
When repair has taken place.

Disease of the Hip-joint attended with Suppuration.—These are the worst cases of joint disease, for suppuration of a joint generally means its disorganization; and when the disease has its seat in the bone, necrosis or some serious inflammatory change is indicated. Under these circumstances all free movement of the head of the bone will probably have long disappeared, and more or less anchylosis or natural repair have

FIG. 541. FIG. 542.

Lordosis of spine in hip disease from flexion of thigh.

Lordosis.



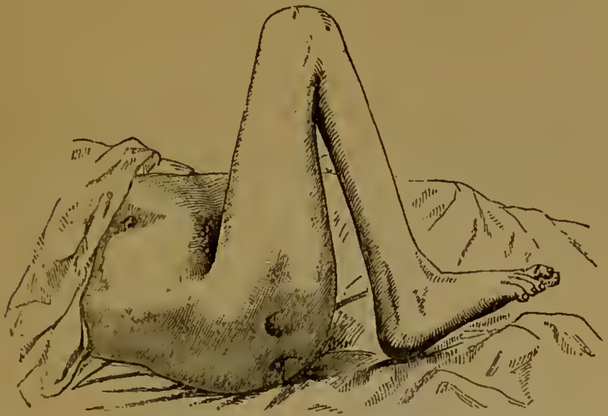
Anchylosis of left hip at 130°, producing lordosis when patient is erect.

Lordosis remedied by raising limb.

taken place, for in joint affections reparative and diseased actions run much together. The limb may be found in any position, the flexed and adducted position of the thigh being the most common, particularly in neglected cases, as illustrated in Fig. 543; but, at times, the thigh will be rotated outwards, and even abducted. When sinuses exist a probe may detect diseased bone. When the pelvis is involved in the disease a finger passed into the bowel will often detect any swelling about the floor of the acetabulum.

When sinuses exist.

FIG. 543.



Disorganization of hip-joint. From patient—Sarah B—, æt. 22, July, 1870. Excision of the joint was performed in this case, and a good result followed.

When dislocation is present.

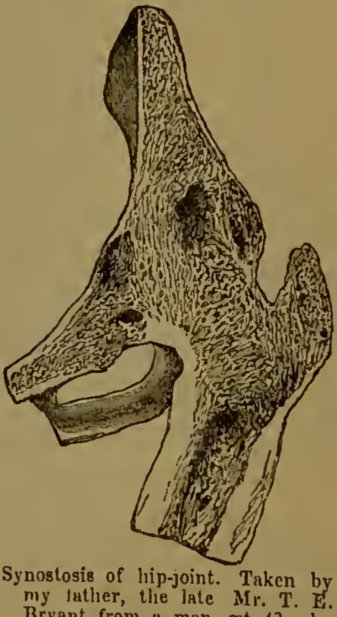
When dislocation is present the symptoms will indicate its form.

Suppuration not always a direct result of disorganization.

All cases, however, of suppuration about the joint, even when associated with disease of the joint, are not to be regarded as a direct result of disorganization of the articulation; since it is quite certain that inflammatory mischief may exist in the joint and subside, and yet be followed by suppuration in the cellular tissue about the part; and in this opinion pathological does but confirm clinical observation. There may be some difficulty in making out such cases during life, but I have no doubt as to their existence. In the hip they are the more common.

Prognosis.—When hip disease can be arrested in its early stage a complete recovery may take place, more particularly when it has its origin in synovial inflammation, although when due to articular ostitis, and the disease has been of long standing, a recovery will probably ensue with anchylosis.

FIG. 544.



Synostosis of hip-joint. Taken by my father, the late Mr. T. E. Bryant, from a man, æt. 42, who had had a stiff joint for thirty years. Prep. 1318^{48}, Guy's Mus.

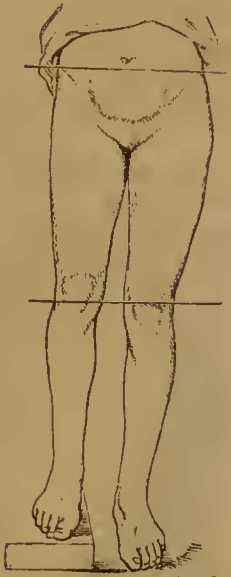
When the joint has suppurated, and a natural recovery follows, it must be, in the large majority of cases, with fibrous or soft anchylosis; and in the minority with bony. In the 'Medical Times and Gazette' for 1869 I illustrated all these points fully by a series of cases.

A very beautiful example of bony anchylosis is represented in Fig. 544.

Arrest of growth in the bone may result.

It sometimes happens when articular ostitis has attacked the head and neck of the femur in childhood, and recovery has taken place with either a movable or anchylosed joint, that some arrest of growth in the bone may be the result. I have seen this in a child, who had been under my care when five years of age for articular ostitis, from which she perfectly recovered; the femur on the affected side at the age of eight was an inch shorter than its fellow, the trochanter nearer the median line of the body and the anterior superior spinous process of the ilium; the seat of the shortening was clearly in the neck of the femur, which had been arrested in its growth (Fig. 545).

Fig. 545.



Arrest of growth in the neck of femur as a result of articular ostitis.

On the diagnosis of hip disease.

The *diagnosis* of hip disease is to be made after a careful estimation of the value of the symptoms as a whole, and not upon one or more supposed typical symptoms. The limping of a child with infantile paralysis of the leg has been confused with that from disease of the hip; but the wasting of the limb and the absence of pain ought to prevent such an error. The pain of spinal disease, of psoas abscess, of sub-iliac abscess, of some glandular affection of the groin associated with limping, and nerve pain extending down the limb, may mislead; but the knowledge of these facts may prevent the repetition of such mistakes. A congenital displacement of the head of the femur has been frequently mistaken for the affection (*vide* p. 394).

Disease of the bursa.

Disease of the bursa connected with the psoas muscle in front of the joint, which at times communicates with it, may render the diagnosis difficult, but the pain on pressure in front of the joint which exists in disease of the bursa, and the pain on pressure behind the trochanter in hip disease, is enough to distinguish the two. Disease of the bursa beneath the gluteus maximus muscle may also at times simulate hip affection, but with care the two affections can be distinguished.

Diseases of the Knee-joint.

On disease of the knee-joint.

Statistics.

This joint is probably more frequently the seat of disease than any other, and in hospital practice my own statistics tell me that it forms 40 per cent. of the joint cases admitted into Guy's. The greater liability of the knee to injury, the thinness of its natural covering, and the complicated formation of the joint, together probably afford the true explanation of this fact. It is met with, moreover, in patients of a more mature age than hip disease, 62 per cent. of hip cases and only 32 of knee disease being found in children under ten. It must be admitted, however, that the knee when once diseased is less likely to undergo a natural cure and much less a cure by anchylosis, than any other articulation. This is probably to be explained anatomically by the existence of the inter-articular fibro-cartilages, which, while in a healthy joint they tend to keep it healthy, in a diseased, by forbidding the contact of the two bones, render it difficult for anchylosis to take place, since they must be partially at least got rid of by some suppuration or other change before anchylosis can be secured.

Less liable to repair.

Presence of inter-articular cartilages.

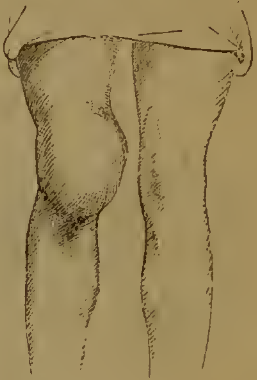
When diseased, there is no joint, however, in which the changes can be better recognised, or the clinical evidence of disease in the synovial membrane or bones be made out with greater facility.

Diseased changes more easily recognised.

Local symptoms of synovitis.

IN SYNOVITIS, acute, sub-acute, or chronic, the synovial sac becomes distended; the natural dimples or depression which in health exist on either side of the patella soon disappear, and in their places a bulging of the synovial membrane will be both seen and felt (Fig. 546). The patella, too, becomes pressed forwards, and, on palpation, may be felt to float as upon a water-bed, and readily made on pressure to dip upon the condyles of the femur which lie beneath. The extensor muscles above the patella likewise will be raised by the distended sac, and the soft parts below the patella down to its ligament will project; distinct fluctuation not only being felt across the joint from side to side, but in an oblique direction from above downwards.

FIG. 546.



Appearance of knee-joint in synovitis.

Acute synovitis.

May suppurate.

Acute synovitis of the knee, except as a part of so-called rheumatic fever or pyæmia, is rarely met with, unless as the result of a wound or the extension of suppurating disease into the cavity. It is a most severe affection, and unless speedily arrested by ice, leeching, or those means suggested in the chapter on wounds of joints, ends in the destruction of the joint, and too often in the forfeiture of the patient's life.

When, after suppuration, life is spared and the joint goes on to repair, anchylosis may be secured, and in puerperal, rheumatic, or pyæmic cases, this result is not rarely met with, the joint undergoing the whole series of changes in a few months. This subject, however, will receive attention in the chapter on the suppuration of joints.

Repair after suppuration.

In *sub-acute* synovitis, a far more common form than the acute, the local symptoms are the same, but the constitutional are far less severe, whether the disease be caused by some local injury or by some general cause, such as gout, gonorrhœa, rheumatism, or syphilis; it moreover almost always terminates in recovery.

Subacute synovitis.

To *chronic* synovitis the same remarks are applicable. This affection is often known as hydrops articuli or simple dropsy of the joint, the chief symptom being an excess of fluid. In many of these cases, however, this effusion into the joint is associated with other changes such as are known to exist in what is now recognised as a special affection—the *chronic rheumatic arthritis or osteo-arthritis*. In it the joint becomes so stretched by the effusion, and the ligaments at last become so useless,

Chronic synovitis.

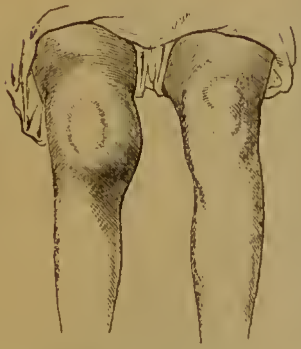
Osteo-arthritis.

that the leg may be made to move about as a flail in every direction. In a large number, however, plates of bones will be found in the synovial membrane or about the articular ends of the bones, as well as bony outgrowths or fringes of ossific matter from the margins of the articular facets, together with other changes, to which attention will be directed in the proper place. It is well, however, to remember here, that a large number of the cases of chronic synovitis or hydrops articuli, are really examples of the peculiar disease known as rheumatic or osteoarthritis.

Articular ostitis of knee-joint. Characters.

In the articular ostitis of the knee-joint the expanded bones are soon made out on comparing the sound with the affected limb, for the articulation thus affected acquires a special shape which is not to be misinterpreted, the condyles of the femur and head of the tibia assuming a globular form, the soft parts covering in the bones being healthy and movable, and no effusion existing in the joint (Fig. 547). At times, a joint so affected, will become two inches larger than its fellow; when effusion is present, the extension of the inflammatory action from the bone to the joint itself is indicated, the case being clearly a more severe one.

Fig. 547.



Appearance of knee the seat of articular ostitis.

The condyles of the femur or head of the tibia alone may also be the seat of suppurative disease, of an acute or chronic abscess, these local bone abscesses being probably more common in the head of the tibia than elsewhere. Under these circumstances, the enlargement will be confined to the bone affected, until the abscess burrows into the cavity of the joint when the joint becomes inflamed. This suppuration may occur with or without necrosis. Fig. 559 illustrates a case in which diseased joint followed necrosis.

On pulpy disease of the synovial membrane. Characters.

In the pulpy disease of the synovial membrane, the local symptoms by which the affection is to be diagnosed are likewise characteristic. In typical cases neither expanded bones nor dilatation of the synovial sac with fluid is present, but the different points of bone which are always to be made out in a healthy joint, are obscured, if not undistinguishable; they are covered in with a soft solid, yielding on palpation over the articular ends of the bones, and more particularly around the patella, a doughy sensation. No fluctuation is to be detected, as a rule, and, when fluid exists, it will clearly be in a thickened capsule. At times, this pulpy thickening of the synovial membrane is a secondary affection, due either to some articular ostitis or to repeated attacks of synovitis. It may also occur as part of a syphilitic disease from the effusion of gummy material around the joint. What Collis described as syphilitic joint, I believe to be of this nature, viz. the pulpy disease, in a syphilitic subject, possibly complicated with periosteal thickening.

Diseases of the Ankle-joint.

On diseases of the ankle-joint.

Nothing particular is to be noticed in the diseases of this joint; their pathology is identical with that of all other joints, synovial mischief being possibly more common than affections of the bone. Effusion into the joint is readily detected by the swelling and consequent pressing forwards of the extensor muscles of the foot, by the fluctuation between the malleoli in front, and at times behind, and along the borders of the tendo Achillis. Bone enlargement is readily seen by the expanded malleolus or malleoli. Bone abscess may occur in either malleolus or in the astragalus.

The pulpy disease makes itself known by some such swelling as is found in synovitis, but the swelling will not be due to fluid, but to the presence of the lowly organised tissue found in the disease, showing itself in a doughy swelling around one or both of the malleoli and beneath the extensor tendons.

Disease of the Tarsal and Metatarsal Joints,

On diseases of the tarsal and metatarsal joints.

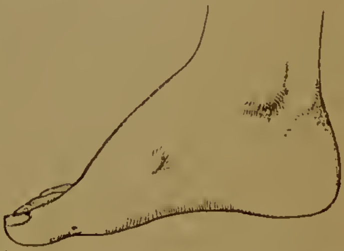
Sub-astragaloid disease.

or, rather, of the bones and joints, is very common; for it is in the bones, as a rule, that the disease begins, the joints becoming involved secondarily. *Disease in the joint between the astragalus and os calcis may*, however, be found alone, and I believe that such disease is commonly the result of some lateral sprain of the ligaments that hold these bones together; lateral sprains of the foot being more likely to be felt at this articulation than at the ankle, as the astragalus is held so firmly between the malleoli. Disease in this joint is to be recognised by the swelling being *beneath* the malleoli; the pain produced by any lateral movement of the heel or foot; and occasionally by the grating of roughened bone. The movements of the ankle-joint will be uninvolved.

Indications.

Disease of the other tarsal or metatarsal bones is indicated by the enlargement of the bones, as well as by the position of the sinuses leading down to them. The scaphoid bone and joints are frequently affected, this bone being the keystone of the antero-posterior arch of the foot; and when the scaphoid is affected, the disease very commonly extends to the cuneiform bones, there being but one synovial capsule common to the scaphoid and the three cuneiform bones.

FIG. 548.



Appearance of foot after the removal of the scaphoid, cuboid, and three cuneiform bones.

Appearances of the foot.

Case.

The form of the foot in these cases is very peculiar. "It assumes," writes Erichsen, "a remarkable bulbous or clubbed appearance; the fore part and dorsum of the foot are greatly swollen, glazed, and possibly perforated by sinuses discharging thin unhealthy pus" ('Science and Art of Surgery'). When necrosed, these four bones may be removed, and a good foot left. As a single bone, the cuboid is also not rarely diseased, and may be taken away without any detriment. In the case figured (Fig. 548) the scaphoid, three cuneiform, and cuboid bones were removed, and an excellent foot remained. I removed them from a boy, æt. 8, by simply enucleating the diseased and dead bones from their beds, and disturbing the periosteum and soft parts as little as possible.

Of the **metatarso-phalangeal joints** that of the great toe is the one most frequently diseased, either from injury or otherwise, and when so affected it is troublesome to deal with. There is some reason to believe that the bursæ about the sesamoid bones at the ball of the toe are occasionally the source of the evil.

That of the great toe often affected.

When dead bone exists in these joints it may be removed, and in some cases the joint may be excised with a good result. I have done this on many occasions, and in several a movable joint was secured. *Gouty* affections of this joint are very common and may go on to disorganization. Disease of the joint as a result of a neglected bunion is not rare, but such cases will be treated of in another page.

Disease of the Pelvic Joints

Of pelvic joints.

Symptoms.

is often overlooked or mistaken for hip or spinal disease, yet it has features of its own. It is more commonly met with in adults than in children, and after parturition than as a result of local injury. It is usually chronic. It may be secondary to disease of the bones that form the joint. In its early stage it is characterised by pelvic or gluteal pains which are aggravated by exercise, relieved by rest, and often put down as rheumatic. Lameness is generally present with a very peculiar unsteady, rolling gait. Local tenderness will generally be manifested on digital pressure over the joint, and pain is excited by separating or pressing upon the iliac wings; swelling along the line of joint may also be visible. The thigh may or may not be flexed, but it will be made to move freely when the pelvis is fixed. As the disease progresses, suppuration will appear either in the gluteal region over the sacro-iliac joint or in the pelvis, and when the thigh is permanently flexed, pelvic suppuration is indicated. It is to be distinguished from hip disease by the fact that there is free movement of the femur in the acetabulum when the patient is recumbent; and no spasm of pelvic muscles is experienced. There is, moreover, no swelling behind the trochanter or pain on pressure in the part. In no stage of the disease will there be any shortening of the limb.

Treatment.

In the treatment of this affection the same principles are applicable as in other joints—rest, tonics, good food and air being essentials. As soon as suppuration can be made out, an incision should be made to prevent burrowing; and when dead bone is present it should be removed. I have taken away large pieces of bone from this joint with great benefit.

Diseases of the symphysis pubis.

Disease of the symphysis pubis is very rare, and I have seen it but twice. One of the cases was in a man, who some months before coming under my care was believed to have fractured his pelvis and lacerated his urethra. When I saw him sinuses existed, running down to and into the joint, but no dead bone could be felt. In Guy's Museum there is a preparation, 1314^{50}, in which the synchondrosis is ossified and carious; and a second, 1314^{40}, in which complete anchylosis is present with new bone.

Diseases of the coccygeal joint.

Disease of the coccygeal joint is at least as rare as that of the pubic, although well-marked cases have been recorded. It can readily be made out by thickening over the joint, and pain produced by any movement in the bone; in some cases a distinct grating can be felt with the finger in the rectum on attempting to move the part.

When the disease is clearly established and the joint disorganised the best practice is probably the removal of the bone; and when this is not advisable or practicable the coccygeal muscles had better be divided by a subcutaneous incision to give rest to the joint, but under these circumstances the cure must be slow. The pains of sacro-coccygeal joint disease are much simulated by what Sir J. Simpson described ('Med. Times,' 1859) as coccydynia, which is met with in women when any of the coccygeal muscles are brought into action by walking, running, rising, defecating, or sneezing. This affection may be cured by the subcutaneous section of the coccygeal muscles.

Coccygeal anchylosis may occur between the sacro-coccygeal articulation, or between any of the segments of the coccyx, or between all of them. The bones may retain their normal position, or be so misplaced as to cause the point to be directed forwards or backwards, the former direction being more common.

When this forward condition is present there may be some impediment to natural labour, but not of necessity, since Smellie ('Syd. Soc.,' vol. ii, p. 8) says, in the two cases he had seen, "the women were as easily delivered as those in whom the coccyx is movable." When difficulty is found the bones should be fractured, the labour being aided by forceps if necessary.

Diseases of the Joints of the Upper Extremity.

Diseases of the sterno-clavicular joint.

Diseases of the Sterno-clavicular Joint.—Suppuration of this joint in pyæmia is common, though as an independent disease it is very rare. I have seen but two examples of it, which ended in disorganization. In syphilitic subjects, however, inflammation about the joint is not unfrequent, but such cases rarely suppurate. The disease, when it occurs, is easily recognised, the joint being superficial.

Disease between the sternal segments has been recorded by Hilton. I have seen but two examples of it, and both were complicated with substernal abscess and necrosis. Local pain increased on pressure, and the movement produced on coughing, with swelling, indicate the disease.

Diseases of the Shoulder-joint

Diseases of the shoulder-joint.

Synovitis.

are comparatively rare, and form a very small proportion of the joint cases admitted into a hospital, the majority of such cases being treated outside. Synovitis, however, in all its forms, is found in this joint, as well as cases of articular ostitis, &c. The joint has no special disease.

Suppuration.

When disorganization and suppuration take place the matter burrows down the bicipital groove, and generally makes its appearance in front of the insertion of the deltoid muscle; at times, however, it bursts posteriorly, or burrows beneath the pectoral muscle.

Anchylosis.

If recovery take place with anchylosis, a wonderfully useful limb is often secured, the scapula allowing an amount of movement which is sufficient for most of the duties of life, though it rarely admits of any action above the shoulder. When disease takes place at the junction of the upper epiphysis and shaft, and suppuration follows, the abscess burrows in the same way, and much difficulty may be experienced in the diagnosis of the case, although the thickening about the neck of bone under these circumstances is generally greater than in joint trouble. When inflammation of the bursa placed beneath the deltoid muscles exists, some of the symptoms of shoulder-joint disease are present, but the fact that the least action of the deltoid muscle excites pain in bursal disease when the movement of the arm by the Surgeon does not, and that the joint moves freely, although possibly attended with a sense of crepitation, ought to suggest its nature.

Diseases of the Elbow-joint

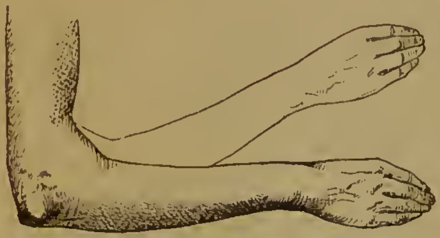
are of great importance, as the value of the hand is greatly dependent upon the integrity of the elbow, and a stiff elbow-joint is a serious detriment. In their general pathology they are the same as similar diseases in any other joint.

Diseases of the elbow-joint.

Synovitis makes itself known by the general enlargement of the joint, as well as by the sense of fluctuation on either side of the olecranon process. Pulpy disease is recognised by the presence of the doughy, semi-fluctuating products that have been poured out in the same position. Articular ostitis can be recognised by the expanded bones.

In a general way, elbow-joint cases do well, recovery taking place with movement in the majority, while in the minority a natural cure takes place by anchylosis, with or without external suppuration.

Fig. 549.



Drawing illustrating the amount of flexion after recovery from suppuration.

The amount of movement that may at times be secured after a natural recovery from a suppurating joint is very good. Fig. 549 was taken from a boy, æt. 19, who had had a disorganized joint treated by free incisions when ten years of age. In it the head of the radius was displaced outwards. He had as much movement as the drawing indicates. In many cases useful flexion and extension are often secured, as well as pronation and supination, and in some, while these latter movements are preserved, the ulna and humerus are firmly fixed together, and when so, the value of the hand is but little diminished. In several of my own cases I have found, after many years, the rotation of the radius perfect.

Often require operative interference.

But as these good results which may follow a cure by natural processes cannot be calculated upon, it is doubtless a wiser course to submit the majority of cases of disorganized elbow-joint to operative interference, not so much, probably, to remove a disease that is incurable by natural processes, as to procure movement and prevent anchylosis.

Disease of the Wrist-joint

Diseases of wrist-joint.

is not so common as that of the carpal bones and carpo-phalangeal joints; but when it has started in one of those parts it is very prone to be propagated to others. When suppuration takes place, the pus often burrows freely between the tendons, but as long as necrosed bone does not exist to prevent recovery, a good result may be looked for, although probably with some amount of stiffness or even anchylosis. When necrosed bone keeps up the irritation it should be removed. To assist recovery the hand should be secured by a splint in the position intermediate between pronation and supination, such a one being the best. When the hand is left alone it is too apt to assume the prone position—a by no means good one.

Disease of the Radio-ulnar Joint

Of radio-ulnar.

is rarely met with. In a recent case of a middle-aged man that came under my care, it appeared to follow over-action, and gave rise to severe local pain and general disturbance. It was followed by suppuration and relieved by a free incision on the dorsal aspect of the wrist down to the joint. The case terminated by anchylosis.

Diseases of the Phalangeal Joints

Diseases of the phalangeal joint.

Treatment.

are, in their nature, like those of other joints, and must be dealt with upon similar principles, synovitis, pulpy disease, and bone disease, with or without disorganization, being found in all. When the disease is confined to the synovial membrane, and the joint has not disorganized, a recovery with movement may be secured by good treatment. When a natural cure by anchylosis only can be looked for, the question of the removal of the finger may be entertained as a matter of expediency, for a stiff metacarpo-phalangeal joint is a serious detriment, while at the proximal phalangeal joint anchylosis is less injurious, and least so at the terminal one.

In the thumb, amputation is rarely to be thought of, for when recovery by anchylosis from disease of the distal phalangeal joint is probable, a good thumb may be secured, though the same result in the metacarpo-phalangeal joint is so inconvenient that the operation of excision is probably preferable. But every case must be treated on its own merits, and according to its own special wants.

The position of the patient, his occupation, age, &c., should have a powerful influence in guiding the Surgeon to a decision.

ON THE TREATMENT AND CURE OF JOINT DISEASE.

Curability of joint disease.

In the treatment of joint disease the most important point a Surgeon has to bear in mind is its curability, since clinical experience affords convincing evidence that, under judicious management, a large proportion of joint cases can be guided successfully to a complete recovery with either movement of the joint or anchylosis. It is in exceptional cases only that operative interference is required.

The recollection of these facts is a constant encouragement to the Surgeon to persevere with, and to the patient to submit to, the necessary means adapted to secure either of these ends; while it in no way tends to discourage operative interference, when the course or the severity of the disease affords sufficient evidence that surgical interference is expedient or necessary.

As proved by pathological evidence.

All pathological evidence tends likewise to the support of these conclusions, for no one can have carefully examined joints that have been treated by either excision or amputation, or others that have failed to go on towards a successful issue, without being struck by the vast amount of repair that exists side by side with the disease, and by the apparently limited character of the latter; and also without feeling that in many cases where a capital operation had been performed, simpler operative interference would probably have been successful, or that none at all was really required.

As proved by clinical observation.

At the same time it must be borne in mind that while in a pathological sense disease, on account of its limited nature or reparable character, may need no interference, yet, in a clinical aspect, a very opposite conclusion may reasonably have to be drawn; since the disease, by its progressive and weakening tendency, may have demonstrated that the powers of the patient were incompetent to provide, even in limited disease, the stimulus needed for repair.

In the treatment of joint disease, however, it is not always a question as to the possibility or impossibility of securing a successful issue by simply aiding natural efforts, since questions of expediency come before the Surgeon as to the wisdom of making the attempt, or as to whether better results might not be secured by surgical interference.

Early excision advised by some.

Surgeons, moreover, who look upon a stiff elbow- or shoulder-joint as a serious inconvenience and an unsatisfactory result of treatment, consequently advocate early excision of a joint with the view of obtaining movement; and those who have little belief in natural processes guided by art, bringing about anchylosis in disease of the knee, or who think that the time occupied in the attempt is badly spent, advocate a like practice. While some Surgeons are always satisfied with a cure of the disease by natural efforts assisted by art, and remove by operative measures joints or parts of joints when these natural processes have proved themselves incompetent to effect a cure; others maintain that in a large number of cases these natural processes lead only to an undesirable end, and that it is not expedient to trust to them.

Excision recommended by others.

Arguments of expediency.

Arguments of expediency also are used, and in recent times have gained in importance, more particularly as brought to bear upon the question of a cure with a stiff joint, when a prolonged interval of time must of necessity be required to secure the end. In some cases, such arguments are of weight, and worthy of consideration, although as a broad rule of practice it is dangerous to adopt them, for, in the majority of cases, natural processes guided by art are followed by results which leave little to be desired, and are secured without the risks which are attached to all operative interference. These points, however, will come out better when the treatment of individual joints has to be considered, and to which attention will now be drawn.

Treatment of Disease of the Hip-joint.

The average total duration of a case of hip disease in which recovery takes place *without* external suppuration is three years, and *with* suppuration four.

On the treatment of hip disease before suppuration has taken place.

So long as suppuration or other disorganizing change in the joint has not appeared, a good hope of a recovery with a useful articulation may be entertained; and so long as the disease is in the synovial membrane the probabilities of a recovery with a movable joint are great.

In a large number of cases where time has been allowed to pass, and disease has gone on to produce degenerative changes in the articular cartilages, recovery with anchylosis is to be looked for; anchylosis without suppuration being more common after articular ostitis than after synovial disease (*vide* paper, by author, in 'Med. Times,' July and August, 1869). When, however, disease originates in the epiphysis of the head of the bone, or in the epiphysial connective cartilage between the epiphysis and shaft, the prospects of a recovery with movement are slight, unless the mischief be checked in its early stage; for, in the former case, the articular cartilage which derives its nourishment mainly from the bone, soon undergoes degenerative changes that can only be repaired by processes ending in anchylosis; and, in the latter, the epiphysis is often cast off as a foreign body, when recovery can only take place on its exfoliation or removal.

Rest—splint.

In both classes of cases, however, the treatment is in a measure the same--that is, the joint is to be at rest, and all inter-articular pressure is to be avoided, for "in diseases of the joints *rest* cannot be too much insisted upon" (John Hunter, 1787); and for these ends the application of a splint is essential, that form of splint being the best which keeps the joint quiet, the pelvis at its normal angle to the spinal column, and the affected limb from being either adducted or abducted; without doubt, these points are best preserved by the double splint figured in 507, 550. Children with this splint well adjusted can be moved with the greatest facility, and, even when there is acute joint disease, with very little suffering. When the acute symptoms have subsided and the disease is clearly going on to repair Thomas's splint is good (*vide* Fig. 550A).

Thomas's hip-splint.

The *hip splint* consists of a long piece of malleable iron, one inch by a quarter for an adult, and three quarters of an inch by three sixteenths for children, extending from the lower angle of the shoulder-blade to the centre of the calf of the leg, to which an iron oval chest hoop, measuring four inches less than the chest circumference, is firmly riveted to the upper end, and two half hoops to support the thigh and calf, as seen in Fig. 550A.

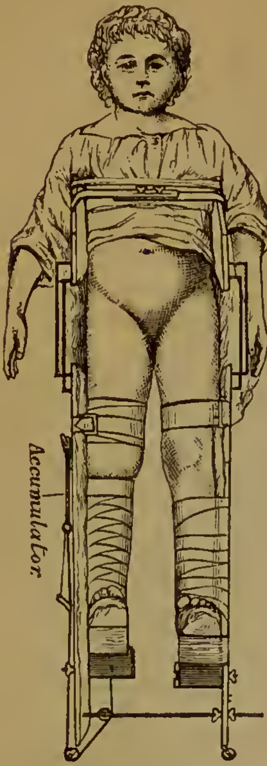
The vertical iron band is carefully modelled to the outline of the trunk and limb, and the chest hoop fitted to the sound side, but away from the diseased. The whole should be well padded, and bound to the body passing in the direction of the sound side over the posterior surface; and if this is efficiently done the diseased limb will be well supported, and the patient, if a child, can be moved readily from room to room.

The curve of the instrument may require alteration from time to time as the flexed limb becomes extended, and the curved spine straight.

Sir C. Bell's suggestion.

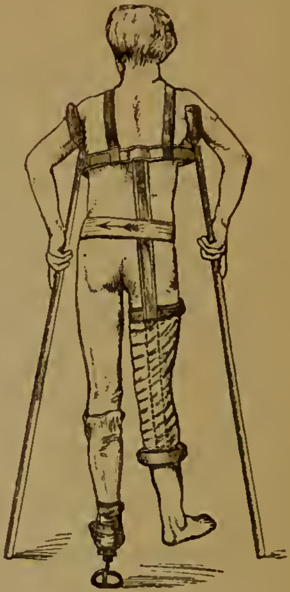
Sir C. Bell clearly saw the necessity of rest, and was so impressed with it as to make the following ingenious suggestion:—"I have observed that patients who have hip disease recover when anchylosis of the joint takes place, when the bones become fixed and immovable. Founding upon this, I attempted by various contrivances to form an instrument which might keep the bones at perfect rest, but so great is the tendency in this joint to motion that I have never yet succeeded. No instrument has ever been effectual in keeping the thigh and trunk fixed." "I have been led to think that an operation might be performed here; *that a cut might be made to expose the upper part of the femur,* and the *neck be sawn through;* not, you will observe, to take away the head of the bone, as done by Mr. White with success, *but to permit it to remain at rest* and to form an adhesion with the acetabulum. In this case a joint will be formed where the bone has been divided" ('Lond. Med. Gaz.,' Jan. 12, 1828. "Hip Diseases," by Sir C., then Mr. Bell).

FIG. 550.



Double splint with elastic extension, as applied in disease of the right hip-joint.

FIG. 550A.



Thomas's posterior splint as applied for hip disease.

When suppuration of joint.

When *suppuration has appeared,* recovery with anchylosis can alone be looked for, though where diseased bone exists this result cannot be expected, unless the diseased bone is cast off or removed. When, however, an abscess has been the result of chronic changes in a pulpy synovial membrane, the complete disorganization of the joint need not as a necessary consequence, be contemplated, although where it has followed disease in the articular extremities of the bones (articular ostitis), it is more than probable that the articular cartilages with the ligaments and synovial capsule will have been completely destroyed. Under the former circumstances, therefore, when the suppuration has taken place as a consequence of synovial disease, recovery may ensue with soft or fibrous anchylosis, or even some degree of movement;

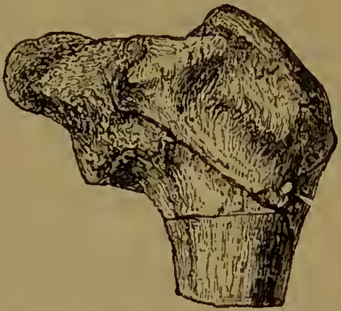
whilst under the latter, though fibrous anchylosis may supervene, osseous anchylosis can only occur after the cartilages with the articular lamellæ of bone have entirely gone, and there is no necrosed bone left to keep up the disease; for, with this complication, a natural recovery cannot take place till the source of irritation has been discharged by natural processes, or removed by art.

Recovery with anchylosis.

When suppuration occurs in a hip-joint, though recovery may follow with partial movement, there is but one result a Surgeon can reasonably look for and strive to secure, and this is anchylosis. If the history of the case and the clinical symptoms indicate that the disease began in the synovial membrane, and that the suppuration was the result of pathological changes in that tissue alone, the hope of securing this result is very good; since the disease in the joint, however extreme it may be, under these circumstances is probably only superficial, and does not involve the bones to any extent, so that a good recovery with a stiff joint may fairly be anticipated. If, however, the history of the case and the clinical symptoms indicate disease of the bones, the probabilities of the same result taking place will rest upon the amount of the disease. If the disease in the bone be superficial, a natural cure by anchylosis may be looked for; since dead bone, if not too large, and even the epiphysis, may be discharged externally, and a good recovery follow. When, however, disease in the bone is extensive (Fig. 551), or a sequestrum is so placed in the centre of the bone as to keep up irritation and interfere with repair, as is shown in Fig. 533, the Surgeon's active interference will be imperatively demanded, and, it may be added, that it is never practised with better results.

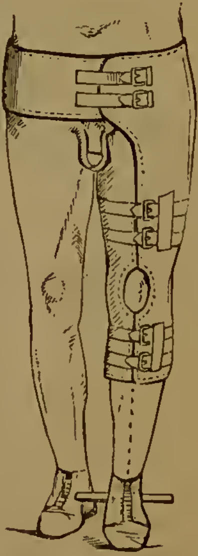
Where surgical interference is necessary.

FIG. 551.



Head of femur altered by disease—removed by excision. Prep. 1318^{39}.

FIG. 552.



Immovable casing of hip disease.

Immobility all-important.

Under all circumstances, however, the first point in treatment is, to secure the complete immobility of the limb, which can be ensured by splints; extension should likewise be kept up by means of weights, or elastic forces. In one case a long outside splint may be enough, while in another the weight is sufficient. In very chronic cases an immovable casing of leather, gutta percha, felt, wire, perforated zinc, or other appliance, such as the fancy or ingenuity of the Surgeon suggests, is the best; absolute immobility of the joint, prevention of inter-articular pressure, tonic treatment, liberal regimen, good air, and time, being essential conditions for a successful issue. Fig. 552 represents a good apparatus to ensure immobility when the patient is in bed, though the double splint figured 550 is better; for with it pressure over the trochanter is guarded against, abduction and adduction of the affected limb are prevented, the pelvis is fixed at a right angle to the spinal column, and the external malleolus of the affected side is kept in a line with the hip; elastic extension is likewise well maintained by means of an accumulator acting through a cord working over a pulley inserted in the cross foot-piece. Mr. C. De Morgan's long splint (Fig. 515) is also good, applied to the side of the sound limb, through which he likewise applied all counter-extension.

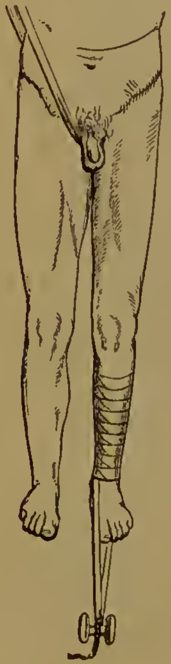
In cases of malposition of the thigh.

Forcible extension.

In case of displacement or dislocation of joint.

When malposition, such as arises from flexion, abduction, or adduction of the thigh exists, a position which would be detrimental to the patient's welfare, it is essential that it should be remedied before the plan of treatment already laid down is carried out, and so long as no anchylosis has taken place, or the union is soft, there is a good prospect of this being effected. For this purpose an anæsthetic should be given, and the thigh slowly but surely brought to a straight line with the body, and there fixed; any inflammation caused thereby being checked by the local application of cold. At times, however, active disorganizing changes and bad results follow. When displacement or dislocation of the joint exists, it is often in the Surgeon's power to reduce the dislocation, and then to treat the case as one of the ordinary kind. In the case from which Fig. 553 was taken the boy was eleven years old; the disease had been acute, and the dislocation was on the ilium. Its reduction was readily effected under chloroform, and a good result followed. A weight of six or seven pounds was enough to keep the limb in position, and the counter-extension was well applied on the opposite side of the pelvis. If, however, I had now the treatment of this case, I should have employed the double splint with elastic extension.

Fig. 553.



When the displacement is of long standing, and the natural cure of the disease has gone on to its end, it is not wise to interfere, and thus run the risk of undoing what nature has well done; as many of these cases of supposed dislocations are not of this kind, but simply a shortening of the neck of the bone from the absorption or destruction of the head or epiphysis of the femur, or, at times, of the acetabulum. Drs. Marsh and Sayre, of New York, deny the existence of a dislocation, but in this they are wrong. It does occur, although rarely. In the case from which Fig. 553 was taken it was very clear.

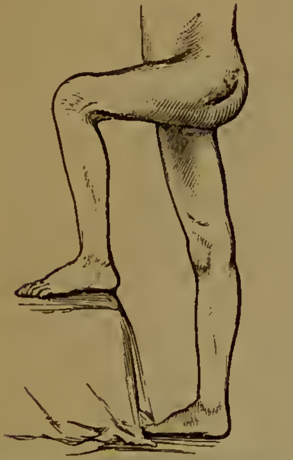
In exceptional instances the displacement of the limb is due to a separation of the neck of the bone from the epiphysis, which is left fixed in the acetabulum, or is cast off. This condition is illustrated in Figs. 537-8.

Anchylosis at a bad angle.

When anchylosis has taken place at a bad angle, at such an angle as seen in Fig. 554, any attempt at forcible flexion with the view of breaking down the adhesions must be looked upon as futile and unjustifiable, although it may be right to consider the propriety of improving the position of the limb by some surgical procedure; and for this object several surgical operations have been devised. Thus, in 1875, M. Tillaux presented before the Surgical Society of Paris a woman, æt. 32, the subject of bony anchylosis of the hip-joint with the limb flexed and rotated inwards, for whom he had with success *forcibly fractured the neck of the bone.* He effected this when the woman was under chloroform by using considerable force, the bone giving way with a loud crack. He subsequently treated the case as one of fracture, and at the end of two months the patient had a straight limb. M. Tillaux described the result as *splendid,* and considered the practice infinitely preferable to the operation of subcutaneous section of the neck of the bone. The operation is, doubtless, of value in certain cases, and worthy of consideration.

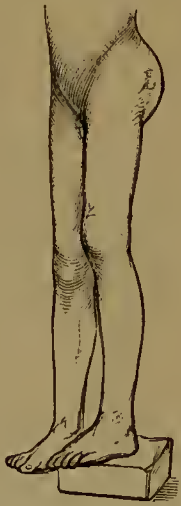
Treatment by fracture.

FIG. 554.



Anchylosis of hip-joint, with femur at right angles to pelvis, before operation. Case of boy, æt. 15.

FIG. 554A.

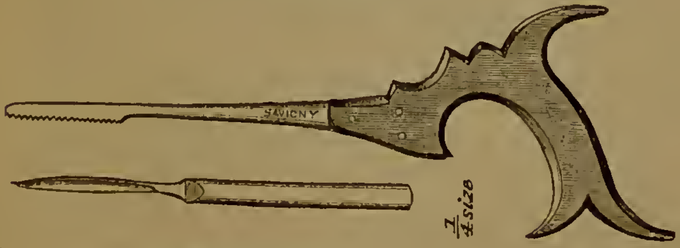


Position of limb after Adams's operation as performed by author.

In 1869, Mr. W. Adams ('Brit. Med. Journal,' 1870) successfully treated a case of this nature by subcutaneous division of the neck of the thigh-bone by means of a fine saw, and since then many operations of the kind have been performed with good success.

By osteotomy.

FIG. 555.

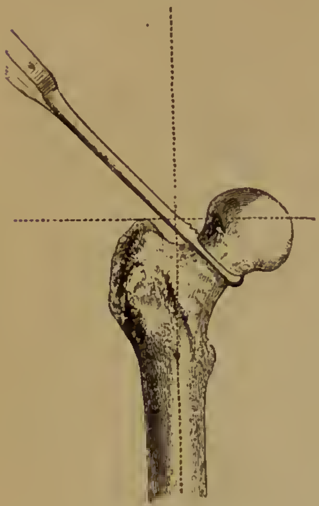


I have performed this operation in a dozen cases, and with so much success that I believe it to be the best when the femur has a neck to be divided.

Operation described.

The instruments required for the operation are such as those figured (Fig. 555). The operation itself I give in Mr. Adams's words: "I entered the tenotomy knife a little above the top of the great trochanter, and carrying it straight down to the neck of the thigh-bone, divided the muscles and opened the capsular ligament freely. Withdrawing the knife, I carried the small saw along the track made—pursuing this by pressure of the fingers—straight down to the bone, and sawed through it from before backwards, in the direction represented in Fig. 556, which shows the saw applied to the anterior surface of the neck of the bone. The section of the bone was accomplished in four minutes. No hæmorrhage followed, and a good recovery took place with a stiff limb." When the saw is used, it should be held at an angle of 135° to the line of the shaft of the femur (Fig. 556). Some Surgeons use a narrow chisel, but I prefer the saw.

FIG. 556.



Drawing showing the line of section of the neck of the thigh-bone in Adams's operation.

Rule for application of the saw.

In my cases the neck of the thigh-bone was readily divided in less than five minutes, and the wound above the trochanter healed in a few days; the patients walking in eight weeks. I have had one patient, a girl æt. 11, in whom both hips were anchylosed in a flexed position against the abdomen, one being adducted and the other rotated outwards. On one side I divided the neck of the femur and on the other the shaft below the trochanters, and with such a good result that the patient can now, six months after the second operation, walk by the aid of a stick and sit with comfort.

I did not attempt to obtain movement in any of my cases, having been well satisfied with the results secured; although I am quite alive to the fact that my friend Mr. Lund, of Manchester, had operated with such success upon a man who had both hip-joints anchylosed in a straight line with the body, and, as a consequence, could not sit, that after the operation excellent motion was obtained in each hip-joint, and the man could sit up in a chair with the body nearly perpendicular, and the thighs comfortably placed on the seat; he could moreover support the weight of the body upon the legs ('Brit. Med. Jour., Jan. 29, 1876).

When there is no neck to the bone

Gant's operation.

When there is no neck of the femur to be divided or the muscles and soft parts about the minor trochanter of the bone are so contracted and rigid as to render it probable that the shaft of the femur cannot be brought down to a right line, Gant's operation ('Lancet,' Dec. 1, 1872) should be performed; that is, the femur should be divided by a small valvular wound subcutaneously below the trochanter, either by means of the saw as employed by Adams, or chisel as suggested by Volckmann and advocated by Maunder, the same care to exclude air being employed in the operation as has been advised in Adams's. Both these operations are superior to Barton's, who divided the femur between the trochanters, and to Sayre's, who excised a wedge of bone from between them.

The Treatment of Diseases of the Knee-joint.

On the treatment of diseases of the knee.

This may be taken as a type of the treatment of all joint diseases.

Acute synovitis.

Acute synovitis is usually the result of a wound, and should be treated according to the principles laid down in a former page, viz. by rest and ice locally, and opium internally. When disorganization of the joint ensues, free incision and irrigation are called for; few cases are more serious in their local as well as their general effects, as life is often endangered, and recovery with a stiff joint must be regarded as favorable. When the disease is the result of septicæmia, or rupture of an abscess into the joint, no better success can be expected.

In subacute and chronic synovitis.

In subacute and chronic forms of synovitis, a good result may, as a rule, be promised, and the treatment must be regulated by the cause of the disease. In traumatic cases, the local application of cold or warmth, according to the amount of comfort one or other affords, and immobility by means of splints, are the best means to use. When all inflammation has subsided and a relaxed condition of joint remains, gentle support, by means of well-applied strapping, is a valuable adjuvant.

In other cases, the application of a blister to either side of the joint as well as the internal administration of the iodide of potassium, with or without bark or quinine, according to the necessities of the patient, are of great use. When gout appears to be an element in the affection, it is advisable to administer colchicum, lithia, and other remedies approved in that disease. When the case appears to have a rheumatic origin, alkalies such as the bicarbonate or citrate of potash, &c., may prove serviceable; and, when there is any reason to suspect syphilitic taint in the constitution, it is necessary to employ such treatment as is peculiar to such diseases, viz. the iodide of potassium or sodium, or some mercurial.

On paracentesis of the knee-joint.

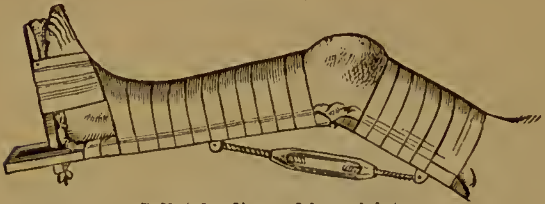
In very chronic and obstinate cases, paracentesis of the joint by means of the *aspirator* may be performed, and, in the hands of some, has yielded marvellous success. Sir J. Fayrer was one of its strongest advocates, having shown ('Indian Med. Gaz.,' 1869) that in the chronic and subacute forms much good is often obtained by the operation, if care be taken to exclude the air by carefully closing the puncture and fixing the joint on a splint; the drawing off of the fluid affording instantaneous relief. I have performed this operation on many occasions with good results when the tension of the joint was extreme; it is a practice, however, that ought to be followed with great caution.

Treatment. In pulpy disease of synovial membrane.

The *pulpy disease* of the synovial membrane is a very obstinate affection, and though fairly curable with a movable joint in its early stage, and occasionally so in a later, is always tedious and unsatisfactory.

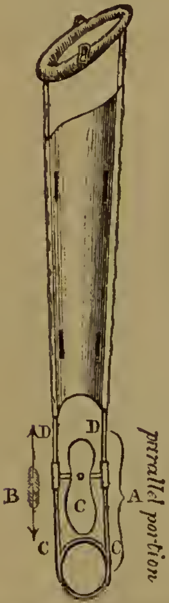
In its treatment the absolute immobility of the joint is most essential. This may be guaranteed by the application of a well-adapted splint (Fig. 557), reaching from the foot two thirds up the thigh, or, what is far better, Thomas's knee-splint, (Fig. 557A), composed of a padded ovoid iron ring, three eighths of an inch thick, to fit well up in the groin, and two vertical iron rods, ending in a patten about four inches below the foot, with an intermediate foot-piece (Figs. 557A and B). An apron of basil leather is stretched between the iron bars for the affected limb to rest upon, in which slits are made for the insertion of a bandage to keep the limb and splint together. When the patient gets up the splint is suspended by a strap buckled to the ovoid thigh-ring, and passed over the shoulder of the sound side, and when he walks upon the splint a patten has to be fitted to the foot of the opposite limb, to maintain the level of the body, Fig. 557B.

FIG. 557.



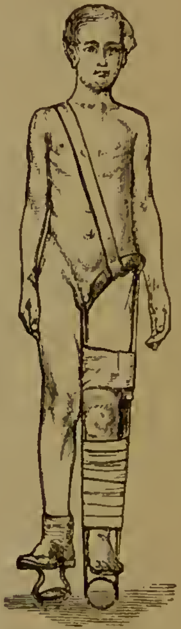
Splint for diseased knee-joint.

FIG. 557A.



Thomas's knee-splint.

FIG. 557B.



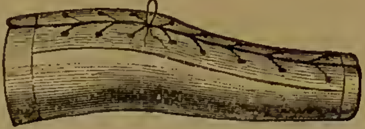
Knee-splint as applied to left limb, with patten on right.

When the knee is much flexed a cushion or pad should be placed behind the knee, which unfolds itself by a gradual process of extension.

As the disease improves, and the dependent position of the limb becomes allowable, the patient can get about by means of a patten on the opposite limb. The introduction of this patten for the above purposes is worthy of all praise.

As long as any heat or periodic flushing of the joint exists, the limb must be kept raised, and warm moist applications applied by strips of lint surrounding the joint. After these symptoms have subsided and the products of inflammation alone remain, well-applied pressure, by means of strapping, is of great value. Mr. Marshall (' Lancet,' May 25, 1872) speaks highly of the five-per-cent. solution of the oleate of mercury in oleic acid as an application, and my experience of its use has been satisfactory. Blistering and firing in this affection seem to be of little value. In the very chronic stage of the disease the Bavarian flannel splint (Figs. 476, 558), or some other good casing may be employed.

FIG. 558.



Bavarian splint, as completed for disease of the knee.

Constitutional treatment.

The constitutional treatment, in all stages of this affection, is essentially tonic, as the subjects of it are always feeble, and often strumous; iron, quinine, bark, cod-liver oil, good food, and fresh or sea air are essential elements of successful treatment.

By these means, so long as suppuration has not set in, a cure may be effected, although many months may be required for its attainment.

When suppuration occurs.

When suppuration appears, the same principles of practice are applicable. When small deposits of pus form from the breaking down of some portion of the pulpy tissues, and make their way externally towards the skin, and not into the joint, they may be evacuated, and a good result still ensue. But when the joint becomes disorganized from the same cause, questions arise as to the expediency or possibility of saving the joint, but this subject will claim attention in the chapter on suppurating joints.

Treatment of articular ostitis of knee. Locally.

In *articular ostitis*, a disease readily made out in the knee, when simple expansion of the bones (Fig. 547), and an aching pain and heat are the local symptoms, all walking or standing should be positively interdicted; everything like inter-articular pressure forbidden; and fomentations of warm water applied two or three times a day, or strips of wet bandage covered by a handkerchief of elastic tissue or oil silk kept round the joint. Some speak highly of blisters, moxas, and counter-irritants, which I rarely employ, having long found the above practice preferable.

When heat has left the joint, the aching, miscalled "growing," pains disappear, and clinical evidence tends to show that all inflammatory action has subsided—the results or products of inflammation alone remaining, local pressure as applied by strapping not only gives comfort to the patient, but appears to help the absorption of the inflammatory products and the subsequent cure of the disease.

Constitutionally.

Constitutional treatment, however, must not be forgotten, and tonics, as a rule, are needed; cod-liver oil, combined with the syrup of the phosphate or iodide of iron, being a suitable prescription for children. When the appetite is bad, quinine may be given; at other times, iron or other tonic. Good food and good air are as necessary in this as in all other joint cases. The use of the iodine evaporating box should not be omitted. Mercury is unnecessary.

In the early stage of articular ostitis splints are not required, as the joint is not itself diseased, and passive movement of the articulation will not do harm; all inter-articular pressure, however should be avoided, and for this purpose extension by means of weights or elastic extension is very valuable. In a more advanced stage, however, when the disease has so progressed in the bones as to have set up some degenerating process in the cartilages, and the synovial membrane has become involved, as indicated by effusion or the pulpy synovial thickening, the use of the splint is essential.

Treatment where joint is in abnormal position.

In neglected cases, when the joint has been allowed to assume an abnormal position—the most common being that of flexion, with some amount of rotation inwards or outwards—and in still worse cases where dislocation of the tibia and fibula backwards has taken place, the deformity, if possible, must be remedied by gradual extension. This should be employed by means of a posterior screw splint, or the application of a constant gentle force exerted through one of the many instruments that have been made with the view of pressing the femur backwards and the head of the tibia forwards. Manual extension exerted under chloroform employed with care rarely does much harm; forcible and sudden extension cannot be recommended, as it is followed at times by severe local action and suppuration. In exceptional cases it may be required.

Treatment of anchylosis.

Anchylosis.—When a knee-joint has to be fixed the best position is one of slight flexion, or that which a man naturally assumes when he stands at ease. But anchylosis is more difficult to secure in the knee than any other joint, on account of the presence of the inter-articular fibro-cartilages, which prevent the bony surfaces from coming in contact. Moreover, these cartilages, when diseased, are most difficult of repair, no tissue undergoing a reparative process more slowly or imperfectly. It is, doubtless, from a knowledge of these clinical truths that some Surgeons despair of securing anchylosis in the knee, and even doubt its occurrence, and are led to interfere by operation oftener than others. Anchylosis of the knee—good solid ossific union of the bones, as well as fibrous anchylosis—does, however, occur, and, when secured, is of great value. It gives a limb which is far superior to any that follows excision, and is, as a rule, obtained without the dangers of an operation, although possibly with the expenditure of more time. I have the notes of many such cases, and in the 'Med. Times,' 1870, I published a series, in some of which this result took place with and in others without suppuration.

Ossific union.

Value of anchylosis.

Treatment of diseases of the ankle.

Diseases of the ankle-joint should be treated on precisely the same principles as those laid down for the knee, the best position of the foot being at an angle slightly exceeding that of a right angle.

Diseases of shoulder.

Diseases of the shoulder-joint, in their progress and treatment, are very similar to those of other joints. When the shoulder has to be fixed a leather casing, including the scapula and humerus, is a good apparatus, the elbow being at the same time supported. The arm should be allowed to hang parallel to the trunk, with the elbow slightly away from the chest; and for this purpose Stromeyer's cushion is of great value (Fig. 497).

Treatment of diseases of the elbow.

Diseases of the elbow-joint can be usually managed with greater ease than any other—a splint applied in the flexure of the joint passing well down to the hand, to keep the radius in a position intermediate between pronation and supination being the best. If the hand is left unsupported it is certain to assume the prone position, which, as a rule, is undesirable. Dislocation of this joint, except at the head of the radius, which is often displaced backwards and somewhat outwards, rarely takes place as a result of disease.

Position of fixing joint.

Before fixing the joint at an angle it is well in most cases to consult with the patient, for in some the straight position is the more desirable. In the case of a painter I had under care a flexed elbow would have lost him his occupation. In another, of a bargeman, the joint was fixed at a right angle, with the hand pronated, to hold the oar. A carpenter asked me to fix his left elbow at an obtuse angle, and a haycutter nearly straight. In all these instances any other position would have been most detrimental.

Diseases of wrist and carpus.

In disease of the *wrist* and *carpus* the same position of the hand should be maintained as in disease about the elbow.

Phalangeal joints.

In disease of the *phalangeal joints*, when anchylosis is to be obtained, I have of late years always fixed the diseased extremity at such an angle as will allow its point to come in contact with the top of the thumb, having invariably found the straight positions of the finger very inconvenient. In this position the fingers are more useful and less in the way, and the deformity less observed. In these cases the best material to use as a splint is a piece of zinc or tin, which is firm, thin, and takes up little space.

ON OPERATIVE INTERFERENCE—EXCISION AND AMPUTATION IN JOINT DISEASE.

General remarks.

In the treatment of joint disease, next to the preservation of life, the aim of the Surgeon is, to preserve the natural movements of the articulation; and, when that hope has gone, to save the limb. If this end can be obtained with a stiff joint, the result in disease of the lower extremity may be regarded as satisfactory, and even in the upper, a stiff shoulder or elbow-joint, at a useful angle, is not so bad a result as some would lead us to believe.

Questions for decision.

When neither of these ends appears probable, possible, nor expedient, from the extent of the local disease, the general want of power of the patient, or the necessities of the individual case, the question of operative interference comes before the Surgeon, and he has to decide on the expediency of an incision into the joint, the removal of dead bone from or excision of the joint, or amputation; and to work out the many points involved in the solution of these questions is a task of difficulty, since, from joints having a different value in the human body, a form of practice which is applicable to one may be inexpedient to another. This difficulty, moreover, is doubtless aggravated by the different value which Surgeons place on different forms of practice, and the different estimation in which they regard natural processes. One who has great faith in natural processes in the cure of disease, and particularly of joint disease, will attempt to save a limb that another will condemn, since he regards any practice as wrong that interferes with a natural recovery so long as any reasonable hope exists of securing such a result; and believes that a cure by anchylosis, however acquired, and however long a time may be passed in securing it, is worth the attempt. Another, who has stronger faith in surgical treatment, will excise a joint, believing it to be inexpedient to attempt to obtain a natural cure, even if it may be gained, when by excision an

Varieties of opinion respecting operative interference.

equally good if not better result can be secured in a shorter time; and a third, looking upon both forms of practice as too protracted and uncertain, will remove the diseased parts by amputation, under the conviction that a more certain as well as a more rapid recovery, will be secured by such a process.

To lay down any definite rules upon operative interference in joint disease generally, is consequently an impossibility, since each joint has its own surgery.

Rule respecting operation.

It may, however, be stated as a starting-point, that no surgical operative interference is justifiable unless a joint has suppurated or become disorganized; and that amputation should only be thought of when all minor measures are inapplicable, and it is necessary to remove the disease to save life. The larger the joint the greater the dangers of operative interference.

The Treatment of Suppuration of the Hip-joint.

Treatment of suppuration of hip-joint. Free incision.

In the treatment of a suppurating hip, as of any other joint, it is important to ensure a free vent for all discharge, as pent-up pus is always injurious; with this view a free incision into an abscess connected with the hip, or the free opening of a sinus through which pus slowly flows is sound practice. In the residual abscesses of repairing joint disease it is well, however, not to incise unless they show a tendency to increase, since many often dry up spontaneously. When these abscesses are interfered with the pus should be drawn off with the aspirator.

On the Removal of Necrosed Bone from and Excision of the Hip-joint.

Excision of hip.

When the presence of dead bone can be made out in a suppurating hip-joint there can be no question about the propriety, nay, necessity for its removal, since it is certain that so long as dead bone remains to keep up irritation, a cure by natural processes is impossible. If this can be effected by means of a free incision nothing more is needed; when the os innominatum is involved there is a greater reason in favour of the removal of the sequestrum. An operation undertaken upon the hip-joint, under these circumstances, is scarcely more than any severe operation for necrosed bone, and in all probability is not more dangerous. The joint, as a joint, has to a certainty disappeared altogether, and a free incision into it will hardly add to the dangers of the case. In a large number of cases, however, this cannot be done, and under such circumstances, when a cure by natural processes cannot be looked for, the best practice lies in excision of the head of the femur, and, if the acetabulum is superficially affected or stripped of its cartilage (the disease being probably secondary to that in the femur) it will undergo a natural repair as soon as the cause of its disease has been removed.

Cases favorable for excision.

When presence of dead bone cannot be made out.

When the presence of dead bone cannot be made out, or the weight of evidence tends to show that there is no such complication to interfere with a natural recovery, the question of excision of the head and neck of the femur may have to be considered. Those who argue against its adoption assert, and with some truth, that while all these cases of hip disease are capable of a natural repair in patients who have good or even tolerably reparative powers, yet in those who have not, the operation of excision must naturally fail, since as much power is probably needed to effect a cure after excision as is demanded for the natural repair of an uncomplicated suppurating or disorganized joint.

Opinion as interference.

To these latter remarks, however, I am disposed to demur, and while ready to admit, that in all cases of disorganized hip-joint in which there is no disease of the bone to interfere with recovery, a natural cure may be fairly looked for, so long as the powers of the patient keep up, and no signs of failure make their appearance; yet when these signs show themselves, or evidence is adduced that in the battle of disease the reparative are weaker than the morbid processes, and treatment fails to turn the scale in their favour, the expediency of performing excision cannot be disputed. The removal of the source of irritation acts beneficially upon the patient, and many a case has, after the operation of excision, gone on to recovery, which unoperated upon would have eventually proved fatal, the patient being worn out by suppuration and exhaustive efforts to repair.

Statistics of excision of hip.

For the most reliable facts connected with the operation of excision of the hip-joint, I must refer to the report of the Committee of the London Clinical Society published in the fourteenth volume of their 'Transactions,' 1881. In it, amongst much valuable material, are certain conclusions based upon a careful analysis of 203 cases of excision; of 260 other cases in which suppuration existed; and of 124 in which no such complications appeared, making a total of 587 cases. Where excision was performed the mortality was 40 per cent. against 33·5 per cent. treated by rest and extension, &c. A large proportion of the deaths in both classes was from tubercular meningitis. I have lost but 5 out of 30 cases operated upon, and although I cannot say that in the 25 surviving all had useful limbs, I am within the truth when I assert that the majority had; while without the operation, recovery was impossible.

Mr. Holmes, too, in his excellent work on 'Children's Diseases,' gives us 19 cases, of which in a general way one third died from the operation, another third recovered with useful limbs, and the remaining third, although not cured, derived great benefit from the operation.

Analysis of the statistics. Influence of age.

On analysing Hodges' and Good's cases as to the influence of age upon the operation, some valuable facts may be recorded, and out of 46 of Hodges' cases operated upon under ten years of age, 15 died, or 33 per cent.; of 37 cases between eleven and twenty years of age, 21 died, or 57 per cent.; of 12 cases operated upon between twenty-one and thirty years of age, 7 died, or 60 per cent.; and of 6 cases operated upon over thirty years of age, 5 died, or 83 per cent. The analysis of Good's cases indicates the same truths, for of the cases operated upon under twelve years of age, 40·6 per cent. died; between twelve and twenty years of age, 60 per cent. died; and between twenty and fifty-eight years of age, 76 per cent. died.

Deduction drawn from statistics.

Excision for hip disease in young life, therefore, is by no means a fatal operation, two out of three recovering; while from ten to thirty years of age, something less than half recover, but after that period it is full of danger. The operation of excision, like amputation, lithotomy, or any other great operation, is more dangerous as age increases. The important fact that children beyond infancy bear severe operations well should ever be before us, though it is of equal importance to remember, that it is in young life we meet with the best success in the expectant treatment of hip-joint as of other disease.

General summary.

With the fact, therefore, before us, that in selected cases, excision of the head of the femur is not only a justifiable but a good operation let us briefly consider under what circumstances it should be performed, and, from the general facts, as learned from statistics, we find two great results come out clearly:—That in childhood the operation is attended with success, two patients out of three recovering, while in adult life it is attended with great danger, at least two out of three patients dying. In the former case, consequently, the operation may be entertained under circumstances which in the latter would render it unjustifiable. When, then, should excision of the hip be performed? And, first of all, when should it not?

When excision should not be performed.

Excision is *not required* where suppuration or disorganization of the joint has not taken place; because so long as this condition is kept off by surgical as well as by medical skill, a solid hope exists that a cure of the disease may be secured, though by anchylosis.

It should *not* be performed when all evidence tends to show that the bones entering into the formation of the joint are neither extensively involved nor wholly or in part necrotic, and where the general condition of the patient under proper treatment is fairly maintained.

It should *not*, moreover, be entertained for disorganization of the hip-joint the result of synovial disease, unless very obstinate and extensive and the general health of the patient is clearly yielding to the disease, nor should it ever be performed for acute suppurative disease.

When should excision be performed.

Excision should *always be entertained* when it is clear that extensive bone mischief or partial necrosis exists, it being tolerably certain under such circumstances that a cure by natural processes is highly improbable; when suppuration is persistent in spite of good treatment, and when the general health of the patient is clearly being sapped by the local disease, whether that disease be in the bones or synovial membranes, or both; when intrapelvic abscess complicates the case, and in the majority of cases in which displacement of the head of the femur exists.

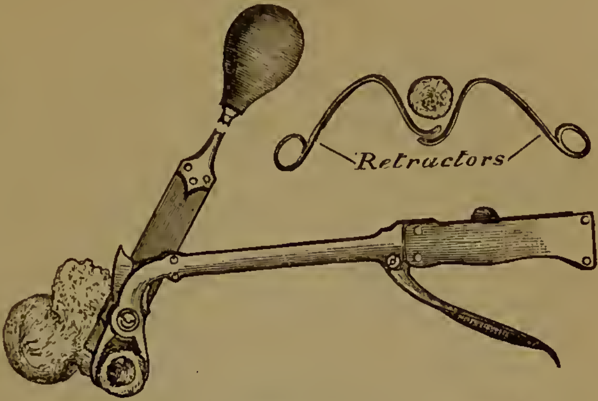
On the operation of excision of hip.

The operation of excision is best performed by a slightly curved incision extending from two to three inches above the trochanter along its posterior border to two to three inches below, more room being obtained when required in exceptional cases at the upper angle of the wound by a cross incision. By this incision there is ample room for the rapid exposure and enucleation of the head and neck of the bone, and subsequently for free drainage.

Some Surgeons remove only the head and neck of the femur, others take away the trochanters as well. The amount of bone does not appear to be a point of much importance since excellent results have been obtained after both forms of practice. In the removal of the bone, the chain saw is often of great use, but I prefer to saw through the bone before removing it, with Adams's saw. For excisions of joints or bones generally my friend and pupil Mr. Gowan has invented a valuable and ingenious instrument; it is composed of a pair of biting forceps for holding the bone, and a saw which works upon a rotating shield fixed to the forceps. By it a bone can be divided when seized with rapidity and safety (*vide* Fig. 558A). The Surgeon should preserve all the soft parts around the bone as much as possible, and, when the

Gowan's excision saw.

FIG. 558A.



Gowan's excision saw, which can be worked on either side of the forceps.

periosteum can be saved so much the better. Dr. Sayre, of New York, who has paid special attention to these cases, describes his operation as follows ('Brit. Med. Journ.,' July, 1871):—"When the disease has gone on to another stage, where sinuses have occurred and discharge pus, when a probe leads down to dead bone, there is nothing to be done but to exsect it by making a small incision above the trochanter major, midway between it and the crest of the ilium, over the top of the acetabulum, a semilunar incision, the belly of the curve covering the posterior part of the trochanter major going straight down to the bone *through* the periosteum; you then pull the soft tissues on one side, and taking a small but strong curved bistoury, go as far round the bone on each side as you can reach, at right angles to your first incision, *so as to divide the periosteum completely.* You then take a strong, firm periosteal elevator, with a large handle, and the end slightly curved, and go into this little triangle; you peel off the periosteum, and, as a matter of course, all the muscles with it; by opening the joint thoroughly, and turning the head of the bone out, the periosteum is peeled off from the inner portion; you then saw off the bone above the trochanter minor, taking away the head and neck of the bone with the trochanter major. After the operation, if you keep the leg pulled out to its proper length, by putting on a pair of wire breeches, you can send the patient out into the air the next day." I have given this operation in Dr. Sayre's own words, and am disposed to think as well of it as of his general treatment of hip disease. His wire breeches, however, I have never used.

Sayre's description of the operation.

Periosteum to be preserved.

When the acetabulum is diseased, that is, necrosed, it may be removed. In many of my own cases, I removed large portions of the bone, and in one, the whole floor with a good result; indeed, there is reason to believe that, when the bone can be removed, the case is not rendered more hopeless; for as Holmes has well pointed out, there is always a strong fascia which separates the floor of the acetabulum from the cavity of the pelvis, and prevents all contact with the viscera or their cellular connections.

Necrosis of acetabulum removal of dead bones.

After the operation, the wound had better be left open to granulate, whilst good extension should be applied during the whole healing process and for some weeks subsequently. My results since I have followed this practice have far exceeded those I obtained previously. My own double interrupted splint is the best for the purpose (Figs. 507, 550).

After-treatment of excision.

As soon as the parts have thoroughly healed, passive movement may be allowed, and it is remarkable to what an extent useful movement is often secured, the patient being not only able to walk upon the limb, but to flex, abduct, and adduct it, nearly as well as he did before, shortening being the only fault.

On the question of amputation at hip.

Amputation at the hip-joint may be entertained in hip disease when all hope of a cure by natural processess, however ably assisted by art, has been abandoned, and when the powers of the patient admit of a reasonable hope of recovery. Also in cases where excision has been performed and failed. Under these circumstances it is often very successful.

Excision of hip in gunshot wounds.

Excision of the hip-joint for gunshot, or other traumatic affections of the joint cannot be recommended. The report of Dr. Otis, in the admirably got-up circulars of the War Department of Washington (No. 2), proves this to demonstration, for out of eighty-five cases only eight recovered; 90 per cent. having proved fatal. At the same time he shows, that, neither by the expectant treatment nor amputation, do better results ensue. He concludes, that excision of the hip may be performed in uncomplicated cases of gunshot fractures of the joint; that if unsuccessful, it relieves pain and is attended with less risk than amputation, although life is probably prolonged for a longer period by the expectant treatment. Professor Langenbeck, however, shows in his able essay on gunshot wounds of the hip-joint, as translated by J. West, of Birmingham, that while of eighty-eight cases in which conservative treatment was employed, 71 per cent. died, out of thirty-one cases treated by resection, 83 per cent. died.

On the Treatment of Suppuration of the Knee-joint.

Operative interference only justifiable when joint is disorganized.

It may safely be asserted that in no case of inflammatory disease of the knee-joint in which disorganization has not taken place should the idea of operative interference be entertained; as, so long as this change is warded off, a reasonable hope of a cure with either a movable or stiff joint and consequently of a useful limb exists. Exceptional cases may be seen in which this rule is inapplicable, but they are rare.

On the treatment of suppuration of the knee-joint.

When, however, suppuration has taken place, the question of operative interference naturally suggests itself, and the Surgeon considers whether natural processes are competent to conduct the case to a successful issue; whether the local disease is of such a nature as to be incurable, unassisted by art, or the general powers of the patient are sufficient to bear up against the demands that of necessity will be made upon them in the progress of a natural cure; and last, but not least, if it is expedient to make the attempt.

When disease in the synovial membrane.

These questions require for their solution much knowledge, thought, and judgment, a careful weighing of the probabilities of the case and of the cause of the disease. When the disease is in the synovial tissue alone and the powers of the patient are good, a cure by natural processes, assisted by art, is generally to be secured; for pathologically in such cases, there is no reason why recovery should not take place. Whereas, on the other hand, when the disease has originated in the bone, spread to the synovial membrane, and been followed by disorganization of the joint, a cure by natural processes is so improbable that the removal of the diseased part by some operation is generally demanded, for pathologically, good reasons exist why recovery cannot take place, and clinically this observation is borne out.

When disease originated in the bone.

It is true in suppuration of a joint from synovial disease, pulpy or otherwise, the result of a so-called rheumatism settling in the knee, or of a puerperal synovitis, a traumatic synovitis, a gonorrhœal synovitis, or any other, a cure with anchylosis is by no means uncommon, yet in all these, during their acute stage, the danger is always great, and it often becomes a question whether an amputation is not needed to save life, or to give the patient a chance. Amputations, however, undertaken for acute suppurative disease are mostly fatal, and operations of excision are likewise equally unsuccessful. Indeed, I hardly think either of these operations justifiable under such circumstances, and in this opinion most are agreed. What I believe to be a better practice is making a free excision into the joint—free enough to let out the pus that it contains, as well as to allow a free escape of all as it forms, and the introduction of a drainage tube, together with the daily washing out of the joint with iodine water. No retention of pus should be allowed under any circumstances.

Free excision.

When suppuration has been set up in a joint from the degeneration of the pulpy synovial disease, the benefit of a free incision is very great, and it should be practised with a good hope of success before any other operative measure is undertaken. When, however, suppuration in a joint has followed the extension of inflammatory mischief from the bones, the hope of securing a good result without operative interference is very slender; since, as a rule, dead bone exists in the joint to keep up irritation, and as long as it remains a recovery is very improbable. It is true, nature does much in many cases towards this end but she rarely is competent to effect the cure without surgical aid.

Removal of dead bone.

In the following cases these points are well seen:

Case.—Disease of the Knee-joint—Suppuration—Removal of Necrosed Bone from the Joint—Recovery with Anchylosis.

Example.

James W—, æt. 17, came under my care in May, 1866, for disease in his right knee-joint, of one year's duration, which had followed a fall upon the part. Swelling appeared directly after the accident, attended by severe constitutional disturbance and local pain. Suppuration also rapidly followed, and several large openings made their appearance eight weeks after the accident. When I saw him the joint was enlarged from inflammatory thickening of the soft parts, and was clearly undergoing anchylosis. The sinuses were discharging, and a probe passed into one readily detected dead bone in the joint. In September the man was admitted into Guy's under my care, and on October 13th, through a moderate incision made on the inner side of the patella, two flat pieces of what were clearly the articular facets of the tibia were removed. Rapid recovery and firm anchylosis of the joint followed.

Case.—Disease of the Knee-joint as a consequence of Articular Ostitis of Tibia—Removal of Sequestrum from Bone—Recovery with an Anchylosed Joint.

Example.

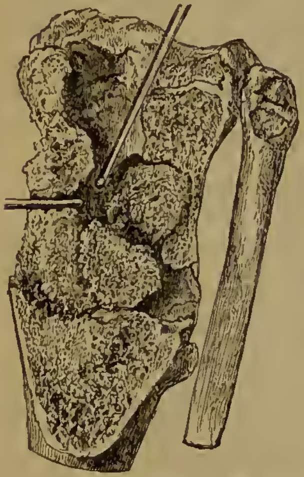
Henry R—, æt. 14, came under my care at Guy's Hospital on May 17th, 1867, for extensive disease of the shaft of the right humerus and head of the left tibia, with sinuses which had existed for several years. The left knee had been enlarged from effusion for a year, but had never suppurated. When admitted, there was necrosis of the shaft of the humerus, and likewise of the head of the tibia, while dead bone was readily felt with a probe in both parts. In the tibia the bone was clearly near the joint, which was enlarged from expanded bone and thickening of the soft parts around. There was no effusion into the joint, and hardly any movement in the articulation. In November, 1867, I removed a mass of diseased bone from the tibia, and fixed the leg upon a splint. In January, 1868, I removed a sequestrum from the arm, which included nearly the whole shaft of the humerus, and a good recovery ensued. In six months the patient left the hospital with a stiff knee and a sound arm.

Case.—Disease of the Knee-joint as a result of Articular Ostitis ending in Necrosis—Amputation—Recovery.

Example

Edward L—, æt. 14, came under my care at Guy's Hospital on September 8th, 1868, for disease in the left knee-joint of seven years' standing, which had been discharging for many years. On admission, the left knee-joint was completely disorganized and much enlarged; it was also partially anchylosed. Below the joint a sinus existed leading into the head of the tibia, and through this sinus dead bone was felt. The boy's health was very bad, and it was clear that nothing but amputation could be entertained. His urine was albuminous. The operation was performed on September 17th, and a good recovery ensued. On examination of the joint which was disorganized the head of the tibia was found to be perforated with a channel which led from the joint to a mass of necrosed bone, and the articular facet of the tibia was likewise necrosed. The disease in the joint clearly had been secondary to the disease in the bone. The preparation is depicted in Fig. 559, and the drawing shows well the condition of the tibia.

Fig. 559.



Abscess of tibia, burrowing into knee-joint with necrosis.

Remarks on the foregoing cases.

Remarks. — These three cases show well the results of articular ostitis when passing on to necrosis in the knee-joint, and fairly indicate the kind of practice that should be applied. In the first case, nature had done her utmost towards obtaining a cure, the knee of the patient being on admission partially anchylosed; and had it not been for the presence of the necrosed articular facets of the tibia a complete natural recovery would have taken place. The Surgeon's duty in this case was clearly to remove from the joint what seemed to be the sole obstacle to a natural recovery, the necrosed bone, and the complete success of the treatment justified the step, for the boy ultimately had an admirable limb. In the second case the disease was of precisely the same character, and natural processes had also done their utmost towards the establishment of a cure, but the presence of necrosed bone in this case, as in the former, interfered with the recovery, and prevented its realisation. On the removal of the bone from outside the joint, natural processes went on without interruption towards the attainment of their end, and a complete recovery with anchylosis was obtained. In the last case, the same cause, articular ostitis, and the same result, disorganization of the joint, were clearly present; but the local disease in the bone was too extensive to allow of any hope of good being derived from its removal, while the general condition of the patient was too precarious to allow of the attempt. As a consequence the only operative interference that seemed justifiable was carried out, and the issue of the case was all that could be desired. In disorganization of a knee-joint, therefore, the result of articular ostitis, of an abscess in the epiphysial extremity of the bone bursting into the joint, of disease in the epiphysial cartilage between the shaft and epiphysis, or of a sequestrum in one or other of the bones entering into its formation, some operative measure is usually required; and when the diagnosis of the case is tolerably clear the practice ought to be decided, as delay cannot be of any use. The disease must be removed. What ought that practice, then, to be? Should it be excision or amputation? Let us refer to facts to help us towards a solution of these points. I have a table of 294 cases of *amputation of the thigh* for chronic disease of the knee-joint, at various ages, and Sir W. MacCormac tabulates 137, the total making 431. Of these, 96 died and 335 recovered, the mortality being 22 per cent., or 1 in 5. On referring to Dr. Hodges' work, I find 178 cases of *excision of the knee* undertaken solely for chronic disease of the knee, of which 70 died, and 108 recovered, the mortality of excision being 39 per cent., or 1 in 2½ cases. In this comparison, the circumstances are exactly similar; both operations being undertaken for chronic joint disease, and the mortality is exactly double. In my table of amputations, I have carefully guarded against any fallacy, and have included only my own statistics,[1] Mr. Callender's,[2] Sir W. MacCormac's,[3] and Mr. Holmes',[4] all of which are equally indisputable; and in the table of excisions I have gone to Dr. Hodges' work, who, to make this point certain, states that, with three exceptions performed for acute inflammation of the articulation, excision of the knee has probably never been undertaken for any other than chronic disease or white swelling. Mr. Swain, the author of the Jacksonian prize essay on "Excision," and a warm advocate of the operation, has given us statistics on this subject, and from his book (pp. 62 and 64) I have extracted the following facts:—Up to 1865, there had been 316 cases of excision of the knee. Of this number 85 died, or 26·8 per cent.; 9 of these died after amputation which had been performed in 39 cases after excision. Since 1865, 74 cases are given, 25 of which died from the operation, or 33·7 per cent.; 4 also died out of 11 that underwent subsequent amputation; in all, 29 cases out of the 74 died, or 39 per cent. Mr. Swain gives us also a select list of cases numbering 82, of which 15 died from the effects of the operation, while 4 others recovered after amputation. We have thus 472 cases of excision of the knee, and 129 deaths, or 27·3 per cent., 13 of these being after amputation; 41 other cases underwent amputation and recovered. Taking the whole number of 472 cases, 302, or 63·9 per cent., recovered after excision; 41,

When operative interference necessary on diseased knee.

Question of amputation or excision.

Statistics of operation.

Swain's statistics of excision of the knee.

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[1] 'Med.-Chir. Trans.,' vol. xlii.
[2] Ibid., vol. xlvii.
[3] 'Dub. Quart.,' August, 1868.
[4] 'St. George's Hosp. Rep.,' 1866.

Results of 472 cases of excision of the knee.

or 8·7 per cent., recovered after secondary amputation; 129, or 27·3 per cent., died after excison: the mortality from excision was thus greater than from amputation in the same class of cases, the relative proportion being 27 to 22 per cent. "It is also," adds Holmes, "a somewhat suspicious feature in Mr. Swain's table that all the 302 recoveries are claimed as being with useful limbs. If the information had been at all adequately full, there would surely have been a category of recoveries with the limb more or less useless;" since it is a well-known fact that the utility of the limb in many cases in which it seemed perfect at first becomes destroyed by subsequent changes. In childhood, suspension of growth is not an unfrequent result, and, when the whole epiphyses are removed, it is to be looked for. It is true that Mr. Swain gives somewhat different results from the same statistics, as he actually numbers amongst the recoveries after excision all cases that subsequently underwent amputation, thus of course giving a far too favorable colouring to the operation he is *advocating.*

Criticisms of Swain's statistics.

Results of excision and amputation at different periods of life.

If, however, we look to *the results of both operations as performed at different periods of a life,* a point of comparison of immense importance although entirely ignored by Mr. Swain and other advocates of excision, and I wish its advocates would consider well these points and not pass them by as of no importance, the following striking result comes out:—In my own table of amputations for chronic diseases of the knee in patients under twenty years of age, out of 69 cases only 3 died, or 4·3 per cent., or one in 23 cases. In excision for the same class of cases performed at the same period of life, out of 97 cases 27 died, or 27·8 per cent., or 1 in 3⅗, the different degrees of mortality of the two operations under twenty years of age being as 4·3 per cent. to 27·8 per cent. *Excision being nearly seven times as fatal as amputation during young life,* it may thus fairly be asked whether the advantages of excision are so great as to justify its performance in the majority of cases of disease of the knee at that age. In amputations undertaken between twenty-one and forty years of age for chronic joint disease, out of 119 cases 38 died, or 32 per cent., or 1 in 3; in excision, undertaken under similar circumstances, out of 74 cases 39 died, or 52·7 per cent., or more than 1 in every two cases, the difference between the mortality of the two operations, 32 per cent. and 52·7 per cent. respectively, being 20 per cent. against excision.

Excision during young life more fatal than amputation.

General conclusion.

Summary.—It would thus appear that it is in young adult life that excisions, although always more fatal than amputation, are the most justifiable; that in childhood they are far too dangerous; while in patients past middle age, all admit their inapplicability. And yet it must be admitted that excision of the knee-joint is a good operation; and that by it, when successful, a far better limb is given than after amputation. The truth must be recognised, however, that the operation is, as hitherto practised, much more fatal than amputation; although it may with confidence be asserted that the cases in which amputation has been performed are, as a rule, far more severe than those in which excision has been practised; for the advocates of excision are disposed to operate at a somewhat earlier period of disease than the advocates of amputation; that is, the former often remove a disease they believe it is inexpedient to leave to be cured by natural processes; whilst the latter only remove a limb when all hope of a natural cure has passed away, and the operation is a necessity to save life. Are the advantages of excision, therefore, so great as to justify a Surgeon in submitting a patient to an extra risk in order to secure them? As hitherto practised, and as a general rule in surgery, I have no doubt in answering in the negative. In exceptional cases, the risk, it is true, may be run; but excision, as a rule of practice, does not appear to be sound. Whether better results would not be secured by an earlier operation is an open question. Prof. Humphry's cases recently published, and my colleague's, Mr. Howse, rather tend to show they would; for, after excisions, undertaken with a patient in good health, or at least not worn out by suppurative mischief, a good result may fairly be expected. But is the risk of the operation when performed under these favorable circumstances, so slight as to justify the Surgeon in throwing aside the hope, and perhaps fair expectation, of securing a recovery by natural processes? Is excision of the knee to be an operation of expediency and not of necessity? We want facts to prove this fully; but, as far as present experience goes, it seems to show that, if the operation is to be a successful as well as a general one in surgery, it must be undertaken at a somewhat earlier period of disease than that at which the question of amputation has to be mooted; that it should be performed before surgical fever has reduced the powers of the patient, and complete disorganization of the joint has taken place. In fact, it should *not* be practised when an operation is demanded to save the life of a patient, for under such circumstances a better chance is given by amputation, but when the local disease is found to be steadily progressing in spite of treatment, and disorganization is threatening. As a substitute for amputation undertaken in extreme disease to save life, facts tell against the practice; as an operation of expediencey to gain time, the few facts we possess tell in its favour. From recent experience, I am disposed to think, that under these circumstances excision is a successful and satisfactory operation. In doubtful cases, amputation is the more desirable as it is the safer operation; and since the great object of our profession is to prolong and save life, other objects ought always to be subsidiary to this great aim. In acute suppuration of the knee, excision is never successful. Excision for gunshot wounds has been proved to be most unsatisfactory; indeed, as a practice in such cases, it seems hardly justifiable. In compound dislocation it has been successful. Canton and M. Spillman have published such cases, but upon the whole, the evidence we possess is not much in its favour in traumatic cases. Resection in cases of deformity as a consequence of disease is probably a better field for the operation; and Drs. Barton and Buck, of New York, have demonstrated its value.

Excision as a rule is not sound practice.

Is excision of the knee to be an operation of expediency?

When excision should not be practiced. When advisable.

Summary of results.

Excision in acute suppuration for gunshot wounds.

In compound dislocation.

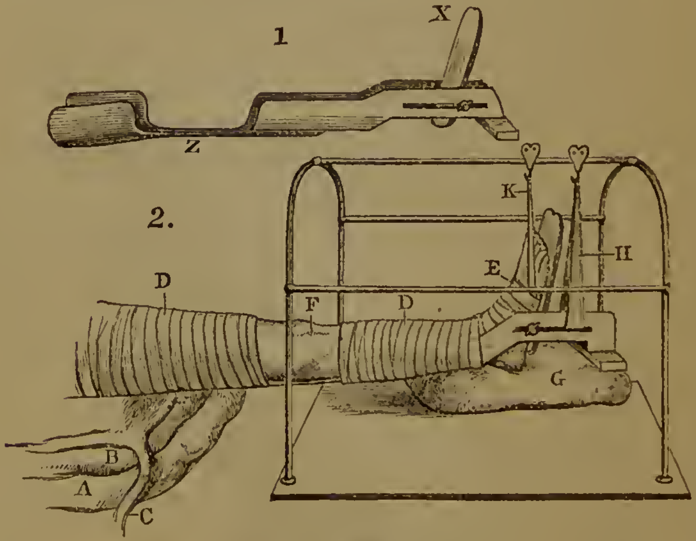
On the operation of excision of the knee.

The Operation.—The best incision is that practised by Fergusson, and suggested by Park; a straight one across the joint below the patella from the *posterior* edge of one condyle to the corresponding part of the other. When the tissues over the knee are bad, the incision may be curved, forming a flap. The old H-shaped incision is now rarely practised. Humphry follows Mackenzie in making the semicircular incision with the convexity downwards, and Bickersteth, of Liverpool, makes a vertical incision on the inner side of the patella.

The joint should be opened at once by dividing the ligamentum patellæ and the capsule of the joint, an assistant flexing the leg fully upon the thigh, thereby facilitating this part of the operation. The soft parts ought then to be turned back off the patella and that bone removed, there being no object in leaving it, but many reasons for its removal. The joint having been freely exposed by the division of the lateral and other ligaments, and by the forcible projection of the condyles, the lower two thirds of the cartilaginous extremity of the femur is to be excised, care being taken not to injure the popliteal vessels which lie in close contact behind; the whole of the epiphysis should not be removed. This section is usually made at right angles to the shaft of the bones, but lately it has been suggested that the surface of the femur should be made convex and that of the tibia concave, or that of the femur should be made wedge-shaped to lessen the risk of any shifting of the bone. To make the section, the bow saw known as Butcher's is the best; the section should be made from behind forwards. In both bones, when possible, it is well not to encroach upon the epiphysial cartilage. In dividing the bone, care is required not to strip off the periosteum above the line of section. When the surfaces are not healthy, or they do not come together well, another section may be made, it being a point of primary importance that a perfect adjustment of the bones should be secured. To aid this, the osseous suture, as first employed by Gurdon Buck, and practised by Nélaton and some English surgeons is to be recommended. All bleeding ought to be arrested by ligature or torsion of the vessels or by hot antiseptic sponges (a point much insisted on by Prof. Humphry) and the parts brought well together by sutures, some immovable apparatus being adjusted before the patient is taken from the operating table. The

Section of the bones.

Fig. 560.



Splint for excision of knee.

Fig. 1. Splint; Z, sliding bar; X, foot-piece. Fig. 2. Limb fixed in splint after operation; A, mattress; B, water-bed with pipe (C); D, waxed bandage; K, longitudinal band to support heel fixed by strapping (E); H, band to support splint; G, pillow.

splint I prefer is the one figured below as used by my colleague, Mr. Howse. It is made of tinned iron, and the limb is fixed in it by a waxed bandage. Dr. P. Heron Watson employs with the plaster of Paris an anterior iron suspension rod. Salter's swing is an invaluable adjunct.

Apparatus necessary for adjustment.

Humphry's method.

Dr. Humphry first fixes the limb upon a posterior splint and foot-piece, then uniting the edges of the wound by sutures, he applies well-padded long splints to the sides of the limb, the wound being left exposed. "I am very particular," he writes ('Med.-Chir. Trans.,' vol. lii), "to adjust things well and firmly in the first instance, and am very unwilling to disturb the limb afterwards. Indeed, I frequently do not remove any of the bandages or splints for five, six, or more weeks, and by this care and perfect quiet I endeavour to promote immediate union. This perfect quiet and abstinence from removal of the bandages first applied is, I consider, a very important item in the treatment. It is equally important not to discontinue the splints till the bones are quite firmly united, till the patient can raise the limb from the bed by its own muscles, without any movement being perceptible between the tibia and femur. It is necessary to make quite sure of this."

Humphry's views of excision of the knee.

Dr. Humphry adds "that excision of the knee is not an operation of much danger;" but it must be remembered that he has little or no faith in the cure by natural processes. He believes such a cure in the bulk of cases to be hardly worth the attempt, and advises that excision should be employed early, so as to bring about by operation that condition which we would gladly see attained without such interference.

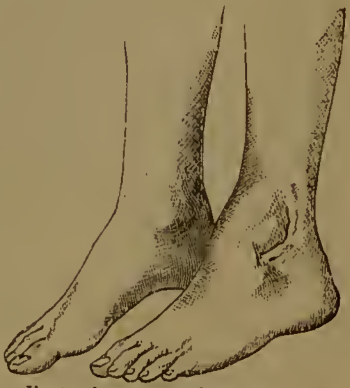
ON SUPPURATION OF THE ANKLE-JOINT.

Treatment of suppuration of the ankle.

Value of free incision.

When the *ankle-joint* has undergone disorganization, and is suppurating, the benefit to be gained by a free incision into the joint is very great, a cure with a movable articulation being often obtained by these means. When this end is not secured a recovery by anchylosis may be looked for, it being exceptional for any more active interference to be required, except when the bones are extensively involved.

FIG. 561.



Foot after removal of necrosed astragalus from child, æt. 6.

When necrosis of one of the bones entering into the formation of the joint is present, recovery may be looked for on the removal of the diseased bone. In the case illustrated in Fig. 561 I removed the necrosed upper half of the astragalus with an admirable result, and a good foot, with some amount of movement, was secured.

When excision may be performed.

Under these circumstances excision of the joint has been practised and with success. I have performed this operation on three occasions, and in two with a good result; in the majority of cases of disorganized ankle-joints I have obtained good results by the expectant treatment and free incision. Excision may be expected to be successful when the disease is limited to the articular surfaces of the bones, and it is in such that the treatment by incisions and the expectant principle is so successful. When the disease is very extensive it is still a question whether amputation is not probably a better practice. Stokes, however, has collected fifty-one cases of excision, thirty-eight of which were successful, and in the 'Dublin Quart.' for 1870, an excellent example by Dr. Murney may be referred to.

Statistics.

Value of excision in compound dislocation and fracture.

In cases of injury, of compound dislocation, and fracture into the joint, excision is probably a sound operation. Mr. H. Lee has recently adopted it in two cases, and Langenbeck has practised it freely with success. Hancock ('Lancet,' 1867) gives nineteen successful examples of the operation, quoting Heyfelder and Jaeger's practice in its support. In such cases, however, it seems well to practise it as a secondary operation.

Barwell's description of the operation of excision of ankle.

With respect to the operation itself, I may quote Hancock's, as practised in 1851, and given by Barwell with recent improvements.

The foot is first laid on its inside, and an incision made over the lower three inches of the posterior edge of the fibula. When it has reached the lower end of the malleolus it forms an angle, and runs downward and forward to within about half an inch of the base of the outer metatarsal bone. The angular flap is reflected forward, the fibula about two inches above the malleolus is thus sufficiently cleared of soft parts to allow cutting forceps to be placed over it, when the bone can then be nipped in two and crrefully dissected out, leaving uncut the tendons of the peronei longus and brevis. The foot must then be turned over. A similar incision should be made on the inner side, the portion in the foot terminating over the projection of the inner cuneiform bone. The flap ought then to be turned back, and the sheaths of the flexor digitorum and posterior tibial tendons exposed, the knife being kept close to the bone, avoiding the artery and nerve. The internal lateral ligament should be severed carefully close to the bone; and the foot is now twisted outwards, when the astragalus and tibia will present at the inner wound. A narrow-bladed saw inserted between the tendons into the inner wound will project through the outer. The lower end of the tibia, and then the top of the astragalus, should be sawn off in a proper direction. The only vessel that may require tying is one of the lower branches of the peroneal artery. The wound can be closed with sutures, except that part opposite the breach of osseous matter; and the leg and foot placed in a splint with a footboard, and cold water applied. Mr. Hancock points out the superiority of total over partial excision of the joint. Mr. Hey, of Leeds, in 1766, was the first Surgeon who resected the lower ends of the tibia and fibula for compound dislocation, and Moreau, in 1792, for disease. Hancock, however, was the first to resect the joint as a whole. This operation has grown in favour during the last few years, and in select cases is doubtless beneficial.

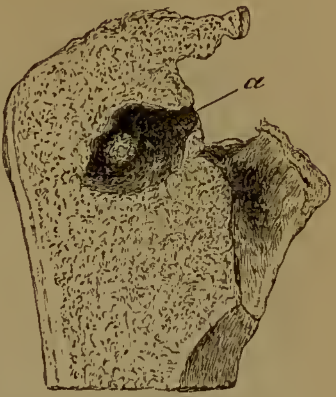
ON SUPPURATION OF THE SHOULDER-JOINT.

On the treatment of suppuration of the shoulders.

Suppuration of the shoulder-joint is as successfully treated by free incisions into and the removal of necrosed bone from the joint as the same affection of any other articulation, and only when this treatment has failed or is inapplicable are more severe measures required.

In the case from which Fig. 561A was taken the disease had evidently commenced as an abscess in the head of the bone, which had made its way into the joint, and downwards through the soft parts to a point below and behind the insertion of the deltoid muscle. It had existed for a year before I treated him, and nothing but excision was applicable, since the abscess cavity contained a small sequestrum, which could not get out. After the operation the patient had a good arm.

FIG. 561A.



Head of the humerus removed by operation, showing an abscess cavity (*a*) in its centre, with small sequestrum and sinus burrowing downwards.

Excision of the Shoulder-joint, or rather of the head of the humerus, is an excellent operation in gunshot wounds of the joint, in compound dislocation, or in cases of disease where a cure by natural processes has failed after judicious treatment, owing either to the extent of disease in the bone, or the general feebleness of the patient's powers. "The ultimate results of excision of this joint, whether for injury or disease, are very satisfactory," says Hodges, but they are not more so than the ultimate results of a cure by natural processes, even with anchylosis; for whatever may be the capabilities of an arm after excision, they are equalled after a natural cure. Under both circumstances, in the majority of cases, almost every movement can be effected except any overhand one, since the arm cannot be raised above the shoulder. A man whose shoulder I excised fourteen years ago was a coachman in 1872, and could drive a pair of horses with ease. A man upon whom Mr. Key operated was subsequently able to carry on his occupation as a hammerman at a large engineer's; and another case, operated upon by the same Surgeon twenty-one years before, in June, 1869, could "shoe horses with any man," and as a blacksmith felt no want in his arm.

Results of excision satisfactory.

Examples of success.

In gunshot injuries to the shoulder, excision is now a recognised operation, the experience acquired in the American war having decided the point. Dr. Otis (Circular 6) has recorded, that in 252 cases of primary excision, 23 per cent. died; and in 323 secondary, 38 per cent.; primary excisions being thus more successful than secondary.

Its value in gunshot wounds.

In cases, also, of tumours involving the head of the bone other than cancerous, excision is an operation of value.

Operation of excision of shoulder.

The Operation.—The best incision is the vertical, from the acromion process through the thickness of the deltoid down to its insertion. Some make an anterior in front of the deltoid. Nélaton used the transverse and Aston Key the deltoid flap. When the vertical incision is made down to the bone, its head should be successively rotated outwards and then inwards, the Surgeon making a transverse cut across the tuberosities to divide the insertions of the scapular muscles. The capsule may then be divided, and the head of the bone turned out of the wound and resected through the tuberosities. The long tendon of the biceps needs no special attention, as in cases of disease it has probably long gone or become fixed to the groove, and after resection of the joint is of no value. When the glenoid cavity is diseased, that is, when dead bone is detected in it, it should be removed; but, in a general way, it requires no treatment. When the vertical incision is employed, it is expedient to make an opening posteriorly through the soft parts at a point corresponding to the upper end of the humerus for the purposes of drainage—this opening being kept patent by means of a drainage-tube. Whatever vessels are divided should be twisted; and the posterior circumflex artery at times gives trouble. After the operation, the arm should be abducted and placed on a pillow, the edges of the wound carefully brought together, and water dressing or dry lint applied. As soon as repair has fairly taken place, the patient may get up, the arm being well supported in a sling. Three or four months, however, are usually required before a useful arm is secured.

Ollier advises the preservation of periosteum.

In this operation, M. Ollier makes much of preserving the periosteum, turning it back off the bone with all the soft parts by means of raspatories. This is not so difficult in cases of disease as might be fancied, a cut with a strong knife down to the bone should so divide all the soft tissues over the bone as to give admission to the edge of a raspatory for the purpose of turning them back. Ollier has done this on four occasions with success. In resecting the bone, no more need be removed than is necessary beyond the head and half the tuberosities; but, when the section is not healthy, another may be made. Four or five inches of bone have been removed in some cases, and yet a useful limb remained.

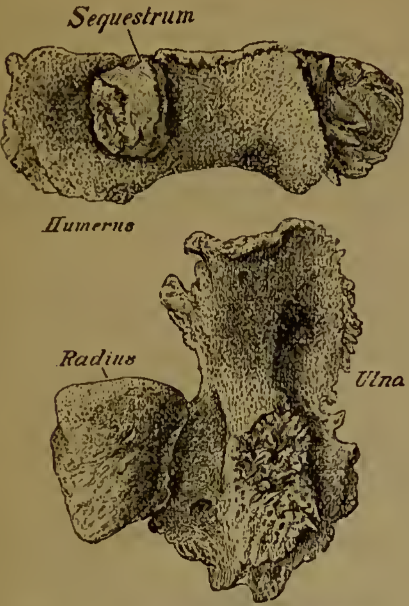
ON SUPPURATION OF THE ELBOW-JOINT.

Treatment of suppuration of elbow.

There is a great difference amongst Surgeons as to the treatment of a suppurating elbow-joint. In the Scotch school, excision is employed very freely, under the belief that a better arm more generally follows such a practice than results from a cure by natural processes, and that a joint with better movement is secured in a shorter time. I cannot say that I agree in this opinion, for in elbow-joint disease, where pus is let out by free incisions and good reparative power is present, recovery with a movable joint, and one admitting of pronation and supination of the hand is by no means uncommon. In other cases, anchylosis of the humero-ulnar joint may take place at a good angle, and pronation and supination of the hand be retained; and when this is the case, the issue so far as the usefulness of the hand is concerned is excellent; while in another class, anchylosis of both bones may take place with a very useful arm; and this result is secured by no greater expenditure of time than is required for repair after excision, and without the risks of an operation. In synovial disease ending in disorganization, this termination is far from being uncommon; indeed, in such cases excision is rarely called for. In bone disease ending in necrosis, however, the same rules do not apply, for under such circumstances no operation is of greater value than excision (Fig. 562). In Fig. 562 the disease was necrosis of part of the humerus; in Fig. 562A necrosis of the head and neck of the radius.

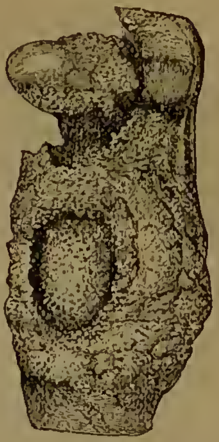
In all cases of disease of the elbow-joint in which natural processes are incompetent to effect a cure, excision should be performed; amputation being had recourse to only when excision is inapplicable or has failed. In cases of compound dislocation, or fracture into the joint, excision is an excellent operation, and to gunshot wounds the same observations apply. Amputation of the arm for injured elbow ought to be performed in quite exceptional cases. Several inches of bone may be taken away in the operation Mr. Tudor, of Dorchester, removed five inches, the patient subsequently having an arm capable of extensive motion in every direction, and with which he could lift a heavy chair (' Med.-Chir. Trans.,' 1858).

FIG. 562.



Parts removed by resection after disorganization of the elbow-joint as a result of necrosis of humerus.

FIG. 562A.



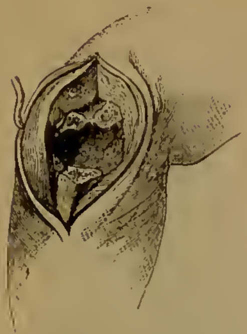
Necrosis of the head and neck of the radius, followed by disorganization of the elbow-joint, removed by resection from a man, æt. 36.

When excision advisable.

Operation of excision of elbow-joint.

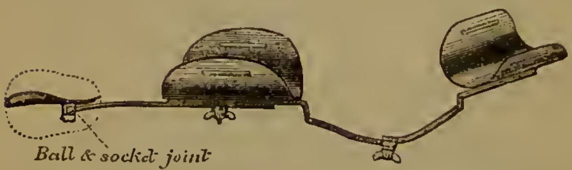
Operation.—The best incision is the vertical one over the olecranon process as practised by Langenbeck and the French Surgeons, extending from three inches above to two below the joint, the incision dividing all the tissues down to the bones. The soft parts should then be carefully separated from the bones and drawn aside, the ulnar nerve being raised from the inner condyle, with the inner half of the triceps tendon and fascia. *No transverse incision across the triceps tendon should be made,* it being a very important thing, as recommended by Dr. R. Hodges, of America (' Hammond's Essays,' 1864), and demonstrated by Maunder (' Brit. Med. Journal,' 1871), to retain the triceps tendon and fascia as it passes over the olecranon, with tho fascia of the forearm and anconeus muscle; a thick body of muscle and fascia being in this way retained, extending from the arm above to the forearm below, which adds materially to the oxtending power and subsequent value of the limb (Fig. 563). The articular ends of the bones should then be turned out and removed. The Surgeon need not be too sparing in his sections. In all cases the whole of the articular facets should be resected, and when the bone at the point of section is not quite healthy a second piece had better be removed. "If only the extreme ends of the bones be sawn off, anchylosis will most likely take place; while if the amount above prescribed, viz. the whole condyloid extremity of the humerus and all the sigmoid cavity of the ulna with the head of the radius, or even little more on both sides, be taken away, free motion may, under favorable circumstances, be expected" (Fig. 564). ('Holmes's System, vol. v.) I have at times regretted not having excised enough of bone, and particularly of the humerus; indeed, I strongly advise the Surgeon in all cases to be free in his section of this bone, more particularly in excisions for anchylosis. When possible, it is well to preserve the insertions of the biceps and brachialis anticus tendons by pressing them back from the bones. To preserve the periosteum in the operation as advocated by Ollier and Langenbeck, does not appear from published facts or scientific reasonings to be a matter of importance.

Fig. 563.



Vertical incision for excision of the elbow-joint. From Maunder.

Fig. 564.



Splint for excision of the elbow, the splint allowing every movement.

After-treatment.

After the operation, all hæmorrhage having been arrested by torsion and the application of cold or very hot water, or, what is preferable, iodine water (ʒij ad Oj) (this mixture checking capillary bleeding), the edges of the wound should be brought together at their ends, a drainage-tube introduced, and the arm fixed at an obtuse angle upon such a screw splint as that made for me and figured above (the splint allowing every movement (Fig. 564)) moderate pressure being applied and maintained for a few hours by means of a bandage. Absolute rest should be maintained till the wound has fairly healed and the powers of the patient have been restored, when passive movement should be commenced with pronation and supination of the hand, the object of this operation being not only to remove the disease but to obtain a movable joint. When anchylosis follows, the operation in a measure is unsuccessful, for it has failed in one of its greatest advantages. In the most favorable cases, the amount of movement that is obtained is all that could be wished, indeed, it is little less than that of the healthy joint; in some cases, however, the joint is too loose like a flail, in others it is stiff, whilst in another class flexion and extension are good, but pronation and supination fail. In Mr. Syme's case of a man who had acted as a railway guard up to the time of his death, nine years after the

Conditions resulting from excision.

operation, when the joint was dissected, the ulna and humerus were united by ligamentous union, and the end of the radius was polished off and placed on the humerus and ulna upon a material much resembling cartilage. If the ulnar nerve be injured, much wasting of the muscles must occur; if divided, union of the ends may, however, take place. Syme has recorded such a case. When disease returns, a second resection may be performed, and even a third. When dead bone follows, it may be removed; indeed, nothing should be left untried before amputation is practised. I have performed the operation twenty-five times, and have never had to resect a second time or to amputate; and in two thirds of the cases good movement was obtained.

Partial resections condemned.

Partial resections of the elbow have hitherto been condemned; past experience having indicated that they almost always end in anchylosis of the joint. In 1864, however, my colleague, Mr. Birkett, excised the olecranon for local disease following an injury, the man recovering after many months' treatment with a slightly movable articulation, and I have recently (1877) done the same in a barrow man, æt. 38, the patient recovering with a joint fixed at a very obtuse angle, with limited movement. I have likewise removed from a disorganised elbow-joint of a woman, the necrosed olecranon process with a good result, the humerus and ulna subsequently anchylosing, while the radius and hand retained all their movements. From the results of partial resections in other joints as well as in the elbow I believe, however, that with our present improved methods of treating wounds these partial operations are valuable.

ON SUPPURATION OF THE WRIST AND CARPAL JOINTS.

On the treatment of suppuration of wrist.

In this affection, operative interference is rarely called for, beyond free incisions for the evacuation of pent-up pus, and removal of dead bone, recovery being aided by the absolute immobility of the hand and fingers, and such constitutional remedies as the wants of the individual case suggest. When, however, such means fail or the local disease is too extensive or severe to allow of a natural recovery, excision of the joint should be performed; Lister, Hancock and others have had successful examples. The best method of performing the operation is that of Langenbeck's, by means of a single free incision over the dorsum of the wrist extending along the centre of the metacarpal bone of the index finger. By this incision the lower part of the radial artery is avoided, and ample room given for the completion of the operation. Through the opening made the carpal bones can readily be turned out and the bases of the metacarpal bones with the extremities of the radius and ulna excised; the tendons of the wrist being held aside with ease. In performing this operation I have been struck with the facility with which it can be effected, and believe it to be preferable to the comparatively difficult and complicated method suggested by Lister, which is to be commenced by an incision made in front over the second metacarpal bone internal to the tendon of the extensor secundi internodii pollicis, and running along the back of the carpus, internal to the same tendon as high as to the base of the styloid process of the radius; the soft parts, including the extensor secundi internodii and the radial artery, being

Excision of wrist.

Langenbeck's operation.

Lister's operation described.

cautiously detached from the bone, external to this incision, and the tendons of the radial extensors of the wrist being also severed from their attachments, the external bones of the carpus will be exposed. When this has been done sufficiently, the next step is to sever the trapezium from the other bones with cutting pliers, in order to facilitate the removal of the latter, which should be done as freely as is found convenient. The operator now turns to the ulnar side of the incision and cleans the carpal and metacarpal bones as much as can be done easily. The ulnar incision is then made; it should be very free, extending from about two inches above the styloid process down to the middle of the fifth metacarpal bone, and lying near the anterior edge of the ulna. The dorsal line of this incision is then raised along with the tendon of the extensor carpi ulnaris, which should not be isolated from the skin, but cut as near its insertion as possible. Afterwards the common extensor tendons should be raised, and the whole of the posterior aspect of the carpus denuded until the two wounds communicate freely together, though the radius is not as yet cleaned. The next step is to clean the anterior aspect of the ulna and carpus, in doing which the pisiform bone and hooked process of the unciform are severed from the rest of the carpus, the former with the knife, and the latter with the cutting pliers. In cleaning the anterior aspect of the carpus, care must be taken not to go so far forward as to endanger the deep palmar arch. The ligaments of the internal carpal bones being now sufficiently divided, they should be removed with blunt bone forceps; next, the end of the ulna is made to protrude from the incision and sawn off as low down as is consistent with its condition, but in any case above its radial articulation. The end of the radius can then be cleaned sufficiently to allow of its being protruded and removed. If this can be done without disturbing the tendons from their grooves, it is far better. If the level of the section is below the upper part of the cartilaginous facet for the ulna, the remainder of the cartilage must be cut away with the pliers. The operator next attends to the metacarpal bones, which are pushed out from one or the other incision and cut off with the pliers, so as to remove the whole of these cartilage-covered portions. The trapezium bone which was left in the early state of the operation, can now be carefully dissected out, so as to avoid any injury to the tendon of the flexor-carpi radialis or to the radial artery, and the articular surface of the first metacarpal bone then becomes exposed and removed. Lastly, the cartilaginous portion of the pisiform bone is taken away, but the non-articular part is left, unless diseased, in which case it should be entirely removed. This remark applies to the hooked process of the unciform. No tendons are divided in this operation except the extensors of the wrist. In order to ensure motion of the fingers, passive movements should be performed from a very early period after the operation. For this purpose, Lister places the limb in a splint with the palm of the hand raised by a wedge of cork fixed below it, so that the joints of the fingers can be moved without taking the limb off the apparatus. When the splint is removed some flexible support is required for some time. (*Vide* Lister's paper, 'Lancet,' 1865.)

Description of operation continued.

After-treatment.

Excision of the joints of the thumb requires no description, and may be made by a vertical dorsal incision that interferes but little with the tendons of the part. The operation is very good, and should always be

Excision of joints of thumb.

performed where possible for disease or injury. I have done it on many occasions with a good result, and at times recovery has been followed by movement. In the case of a man with neglected dislocation in which I performed it, hermetically sealing the wound with lint and the compound tincture of benzoin, rapid recovery followed with a movable joint. In a second case, in which I excised the phalangeal joint of the thumb, a like result ensued.

AMPUTATION IN JOINT DISEASE

Amputation in joint disease, when not to be resorted to.

ought never to be resorted to until all hope of a cure by natural processes has been given up or failed; until incision into or the removal of necrosed bone from the joint has been deemed unsuitable, excision of the joint inexpedient or inapplicable, or the progressive nature of the disease and its sapping powers reveal the fact that if the disease be not removed the life of the patient is likely to be sacrificed. In amputating for joint disease, as for injuries, tumours, or other causes, the principles of "the least sacrifice of parts" should be followed, and no more of the body, under any circumstances, ought to be taken away than the necessities of the case demands. To carry out this principle the Surgeon may, in pathological amputations, fearlessly divide tissues infiltrated with organized inflammatory products, and even cut through the walls of suppurating cavities or diseased joints, more particularly to save amputating above a joint. The value of this practice I have fully illustrated ('Lancet,' Jan. 23rd, 1875).

The principle of "the least sacrifice of parts."

Amputation for disease of the hip, shoulder, and elbow-joint is performed in only exceptional cases, and for the knee and ankle it is yearly becoming less common. Yet it is a valuable operation in proper cases as well as the means of saving many lives. The mortality of amputation for chronic knee-joint diseases, at Guy's Hospital, is only one in seven, and in young people under twenty years of age, one in twenty. In amputation for disease of the knee, where the end of the femur is sound and the articular facet alone diseased the Surgeon should sacrifice as little of the thigh as possible, the amputation should be almost at the joint, and the femur divided through its condyles, or just above, as in Stokes's amputation; a higher section of bone should only be made when the necessity of the case demand it. In disease of the ankle-joint, when excision and every smaller operation such as the removal of dead bone has been put aside, Pirogoff's operation should be employed in preference to amputation, if the calcis with the integument over it be sound; or Syme's amputation, unless the disease of the articular end of the tibia is too extensive. To amputate a sound foot for disease confined to the ankle-joint is a measure which can only be justified by peculiar circumstances, and as a general practice is to be condemned. Amputation of the arm for diseased elbow is still less justifiable, unless the local disease is too extensive to allow of excision, or the powers of the patient too feeble to admit of the attempt.

Site of amputation in disease of knee.

Site of amputation in disease of ankle.

LOOSE CARTILAGES IN THE JOINTS.

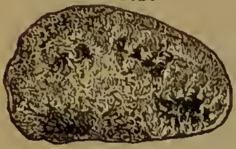
On loose cartilages in joints.

Loose bodies, ordinarily called loose cartilages, are found in joints, and are most common in the knee, yet are met with in the elbow, ankle, and other joints. They are, doubtless, generally developed in

Origin and growth. the sub-synovial cellular tissues, and as they increase in size encroach upon the cavity of the joint by pushing the synovial membrane before them, and appear as warty or more or less pedunculated fringed growths hanging into the cavity. They may be single or multiple, and of all sizes up to that of a small walnut. When one of the masses becomes detached a "a loose cartilage" is said to be present. John Opinions respecting their nature. Hunter taught, and Rokitansky believed, that they are formed by the organization of fibrinous coagula, but evidence is wanting to prove this view, for most, as pointed out by Rainey, contain ill-formed cartilage-cells and ossific matter and true bone-lacunæ are at times present (Fig. 565). Paget ('St. Barth. Hosp. Rep.,' 1870) has recently given good evidence of the truth of Teale's suggestion, that some of these bodies are really sequestra, and that "just as a blow on bone or tooth may induce necrosis and exfoliation without signs of destructive inflammation, so may it with articular cartilage; and the characteristics of these cases will be that after injury to a previously healthy joint, a loose body is found in it, having the shape, and general aspect, and texture of a piece of articular cartilage with or without some portion of subjacent bone, and with its cartilage-corpuscles arranged after the manner of the articular cartilage." Dr. Adams, of Dublin, connects their presence with osteo-arthritis.

Fig. 565.

Natl. size



Section of loose cartilage removed from knee. Prep. 1344^{40}, Guy's Mus.

A report upon these bodies, with microscopical drawing kindly etched for me by Dr. Goodhart, will help to the solution of some of these points:—

Dr. Goodhart's report. "The term 'loose cartilage' is applied to two conditions which are totally distinct; the one where a portion of the normal articular cartilage has been detached by injury to the joint, and lies loose in its cavity; the other where bodies of more or less consistence, often cartilaginous or bony, are found, and which are new formations.

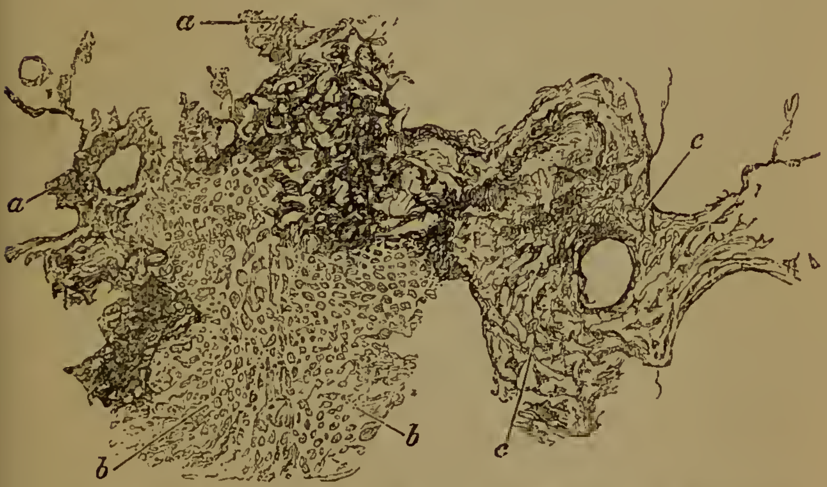
"Recent observations seem to show that the former of these two is by no means of infrequent occurrence, but it possesses no pathological interest whatever, and needs no description. A very good specimen of this form is to be found in the Guy's Hospital Museum, 1344^{62}. The latter, however, has frequently excited discussion among pathologists; so we will give in a few words what appears to be its usual composition, and our conclusions therefrom as to its mode of origin. Roughly speaking, loose cartilages are generally more or less smooth, of greyish colour, and look, as their name suggests, like pieces of cartilage; but they may be nodulated and composed almost entirely of bony material (Fig. 565 and Prep. 956B, Hunterian Mus.). Even in that case, however, they have a thin film of fibrous material over them still, obscuring the bone, and rendering them cartilaginous looking on their external surface.

"The cases (five in all) that we have had an opportunity of examining have also shown more or less calcareous matter; they were never pure cartilage. One case in the Guy's Museum (1344^{20}), while appearing cartilaginous, cut with a creaking sensation, and under the microscope irregular deposits of calcareous matter and bone were found in all directions in its substance. In another (Hunterian Museum Cat., 957A) one surface is tuberculated and composed of hard nodules of ivory-like bone, while in a concavity thus formed is a cartilaginous mass. The bone on the surface in this specimen can only be compared to the nodulated excrescences found at the margins of the articular cartilages in cases of osteo-arthritis.

"The microscopical characteristics vary in each to a certain extent; some show fibro-cartilage, calcareous matter, and bone; others are entirely bony. The cartilage in the specimens which we have examined was very fibrous, and the cartilage-cells small. The calcareous matter had evidently not formed after any definite method, or in any purposive direction, as should occur in the building up of normal bone-tissue, and the bone had no regular system of Haversian canals or bone-corpuscles. The former occur as spaces of irregular shape and position, and the corpuscles, with but few canaliculi, are often more like calcified cartilage-corpuscles, and have no arrangement in relation to them.

"From this short description, and also from Fig. 565A, it will be seen that the specimens exhibit the formation of bone in its various stages; they show the primary cartilage stage, the secondary calcareous stage, and its ultimate issue in true bone, the bone being, as might be expected, of a somewhat irregular build.

FIG. 565A.



Microscopical appearance of loose cartilage. *a.* Calcareous matter. *b.* Small-celled cartilage, in parts more fibrous than represented. *c.* Bone.

Formation of loose cartilages.

"Having thus regard to their general structure, it would then seem most probable that since they are in their essence bony, loose cartilages must form in connection with bone-forming tissue, and these, so far as is known, are found in the involutions of the synovial membrane at the edges of the articular cartilages. This view is consistent also with the appearances found in certain joints in cases of osteo-arthritis; such, for instance, as a case recorded by Mr. Wagstaffe in the 'Pathological Society's Transactions,' vol. xxiv, 1873, p. 192; or specimens 954—956B in the Museum of the Royal College of Surgeons. In all these the formations may be seen *in sitû*. It is also in accord with the generally received opinion as to the more usual formation of loose cartilages at the present time.

"But in connection with this subject the so-called 'melon-seed bodies' found in joints and in the synovial sheaths of tendons and on bursæ must be considered. As is well known, they are generally abnormal developments of the synovial fringes, sometimes inflammatory, sometimes, perhaps, as was suggested by Rokitansky, due to cystic dilatation of the synovial folds, or perhaps to distension and coagulation within obstructed follicles. But whether originating in one or all of these various ways, being all in common due to changes in the synovial membrane and sub-synovial tissue, it is evident that they are loose cartilages in miniature, and only want size and the further change into cartilaginous matter to be true loose cartilages. But I have lately had an opportunity of making a very careful examination of some of these 'melon-seed bodies' from one of the sheaths of a tendon on the dorsum of the hand, which suggested the possibility, not to say probability, of another mode of origin. I failed to find in any of them any evidence of organized tissue whatever. They contained no nuclei or cell-elements, and were entirely composed of a faintly fibrillated hyaline substance characteristic of coagulated mucus or fibrin. Hence it seems to be quite possible that loose cartilages may originate in a nucleus of fibrin precipitated in the course of a chronic inflammation, and that they subsequently grow by accretion, becoming calcareous by central petrifaction. On this point may be consulted a very interesting case of loose body in the peritoneum, recorded in the 'Path. Soc. Trans.' by Dr. Greenhow, vol. xxiii, p. 241. This specimen, in conjunction with 'melon-seed bodies,' makes one reconsider whether the opinion formed originally by John Hunter may not be correct, that loose bodies in the joints are sometimes formed from the 'living principle of the blood.'"[1]

Melon-seed bodies.

Symptoms.

Loose bodies, however formed, give rise to very similar symptoms, produced by the foreign body becoming fixed and pinched between the articular surfaces of the bones. The presence of one of them is usually discovered when the patient is walking or moving the joint by some sudden inability to move the articulation and a severe and sickening pain, which is relieved only by the cartilage slipping from between the bones, which it usually does by a characteristic snap.

Effects.

Some stiffness and slight inflammation of the joint may follow this injury, which by rest and treatment will subside in a few days, to be renewed upon a recurrence of the accident. In such a joint as the knee the cartilage, as often as not, may be felt on manipulation, although readily slipping away under pressure.

Treatment.

Palliative.

The TREATMENT may be described as palliative or operative. By the former, the cartilage is left untouched in the articulation; and by the latter it is removed or fixed in an unoffending position. In a general way the palliative treatment is the correct one to be enforced, for knowing how destructive inflammation of a joint following a wound too often proves, few Surgeons would venture upon an operation without an absolute necessity, and such seldom exists, for by restraining the move-

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[1] For further information *vide* 'Virchow's 'Krankhaften Geschwülste,' vol. i; Marsh, 'St. Barth. Hosp. Reports.'

May be absorbed.

Operative interference.

Mode of performing operation.

Direct method.

ments of the joint by some leather, felt, or other light casing, the foreign body may become fixed, and consequently innocuous; indeed, by such treatment, Hilton has shown ('Guy's Reports,' 1868) that these cartilages may become absorbed. He fixes the loose body by means of a pad and strapping at the most convenient spot, and places the limb upon a splint. By this practice pain is prevented, the peduncle of the cartilage cannot be stretched, nor the cartilage slip between the semi-flexed bones. In 1877 I thus treated a woman who had a loose cartilage the size of a large almond, and in three months, under observation, it gradually lessened until it disappeared. When inflammation of the joint follows one of the attacks of pain it should be treated on ordinary principles. When, however, the cartilage, by its presence, produces such serious inconvenience as to destroy the value or use of the joint, whether from the frequency of the attacks, the amount of inflammation that follows, or the dread connected with the affection, some operative interference may be justifiable, and the cartilage should be removed either by direct or subcutaneous incision; no operation should be undertaken till all inflammatory action has ceased, and the joint is in a quiescent state. With the view of removing the offending body by direct incision, a practice which has gained ground in recent times, a splint should be applied and worn for at least a week; the loose body should then, by manipulation, or by such movement of the joint as the patient from experience knows will bring the cartilage under the Surgeon's control, be brought up to one side of the joint (and in the knee, its usual seat is on one side of the patella), where it may be fixed with the finger. The Surgeon may then draw the skin over it to one side, and cut down directly upon the cartilage, the incision being large enough to allow of its escape. The wound having been well washed with an antiseptic lotion, should be closed by sutures dressed with iodoform or carbolic gauze, and the limb kept upon a splint till repair has been perfected.

Subcutaneous method.

Square's experience.

The removal by subcutaneous incision consists in the fixing of the cartilage by means of a grooved or harpoon-shaped needle inserted into its substance through the skin; of, next, the introduction of a tenotomy knife beneath the skin down to the cartilage, and the division, by a free sweep of the knife, of all the subcutaneous tissues covering it in; then of the dislodgement of the cartilage by the application of strong digital pressure, or tilting it by means of the grooved needle into the cellular tissue of the parts around, and the application of a pad of lint over the spot where the cartilage escaped from the joint; finally, absolute rest of the limb upon a splint must be subsequently enforced, and an ice-bag applied over the joint. After this operation, a small blister may be applied over the cartilage in the cellular tissue; Syme having found that by such means the foreign body becomes fixed in its new position, and subsequently absorbed. To remove it by a subsequent operation is a recognised though rarely required measure. Mr. W. J. Square, of Plymouth, adopts the indirect operation, but, instead of squeezing the cartilage completely through the subcutaneous wound, he is satisfied by simply pressing the foreign body into the subcutaneous opening, and fixing it there by compress and strapping. At the Brit. Med. Assoc. for 1871 he related twenty-four successful cases. The subcutaneous operation has hitherto been considered the safer of the two described; but with our improved methods of treating wounds the operation by direct incision is said to be equally safe. We, however, want facts to establish this point.

Larcy's statistics.

M. Larey's statistics ('Gaz. des Hôpitaux,' No. 67) fairly support the indirect method:—Out of 129 cases operated upon by the direct method 28 were fatal; and only 5 out of the 38 by the indirect. He concludes, after a careful analysis of cases, that the operation is a serious one when practised by direct incision, and a difficult one by the subcutaneous method, while extraction is more dangerous than the persistence of the affection. He believes the operation is indicated by the complete mobility of the foreign body within the joint; the persistence of the accidents caused by its presence, viz. pain, arthritis, and lameness; the failure of acupressure and other means for fixing the position of the foreign body; and the free consent of the patient after having been made aware of its dangers.

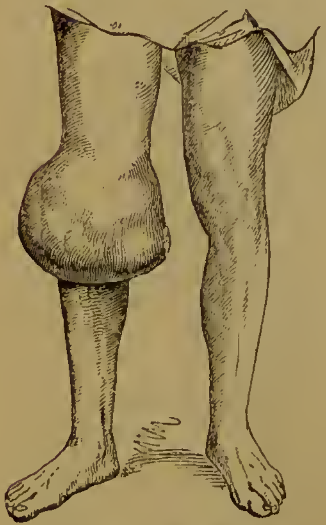
RHEUMATIC OR CHRONIC OSTEO-ARTHRITIS.

On chronic rheumatic arthritis.

This affection, originally described by J. Haygarth ('Clinical History of the Nodosity of Joints,' 1813), and accurately depicted by Cruveilhier in his 'Pathological Anatomy,' 1813, is now a well-recognised affection, thanks to the labours of the late Dr. R. Adams, of Dublin, and his splendid monograph published in 1857; to Prof. Smith, of Dublin, and Canton, of London. It is chiefly seen in the middle-aged or old, though occasionally in young people. It may attack any joint, but is most common in the hip and shoulder, and generally comes on without any definite cause, yet I have known it, in not a few, follow directly upon some injury. A large number of cases put up as unreduced dislocations in the different museums are doubtless examples of this affection; the displacement of the head of the bones being the result of the disease. It is unfortunately called rheumatic, although it has no apparent connection with

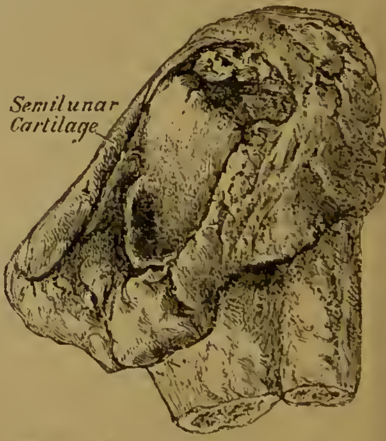
Character of the disease.

FIG. 566.



Osteo-arthritis of knee-joint. Drawing 33^{00}.

FIG. 567.



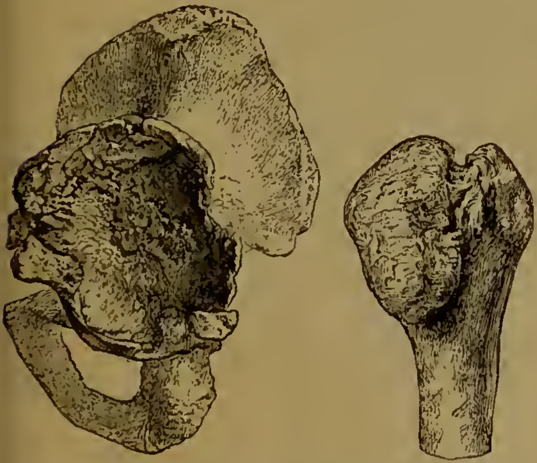
Wearing away of the head of the tibia in osteo-arthritis.

what is generally called rheumatism. It has probably acquired the name from its chief local symptom of aching pain in the joint, aggravated at night and in damp weather. The disease is at first associated with a dryness of the joint, but subsequently with excess of secretion even to a great extent; with some thickening and expansion of the head of the bones entering into its formation; some eburnation of the articular lamella of bone with disappearance of its inter-articular cartilage after it has undergone the fibrous degeneration; and, with what is still more peculiar, the deposition of new crests (osteophytes as they are called) or plates of bone around the margins of the articular facets and in the ligaments and synovial membrane. These crests often appear as ridges of bone which can readily be made out, and the plates may simulate a second patella when the knee is the joint involved. In the case from which Fig. 566 was taken, all these conditions were readily distinguishable; the bones and synovial capsule being enormously enlarged; the ligaments were so stretched as to allow of some lateral movements in the joint; and the characteristic rough, crackling sensation, which movement of the joint always gives, was most marked.

Symptoms and pathological changes which take place.

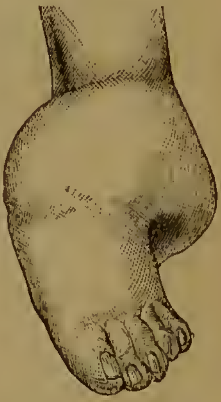
In still more extreme or neglected cases, the end of one indurated bone will grind away in time that of its contiguous bone, the condyle of the femur having in the case from which Fig. 567 was taken ground down for at least an inch the head of the tibia. The preparation was made from the amputated limb of a man æt. 36, the leg having been taken off at the knee-joint, because the limb was a flail and the joint threatened to become disorganised; and an excellent stump was left.

Fig 568.



hanges in the head and neck of the femur and in the acetabulum in osteo-arthritis. Preparation 1131^{59}, Guy's Hosp. Mus.

Fig. 568a.



External appearances of the ankle, the seat of this disease.

In the hip-joint.

When the hip-joint is diseased, the head of the bone flattens down, the neck shortens, the cup of the acetabulum becomes saucer-like, and around its margin as well as around that of the head of the femur, an irregular crust of bony outgrowths forms (Fig. 568); the cartilage likewise disappears, and the articular surface of the bones presents a dense eburnated appearance. In the knee-joint, one or both of the condyles of the femur becomes elongated and expanded, the head of the tibia flattened, the patella enlarged, and *osteophytes* of variable forms and dimensions fringe the margins of the bones. The synovial membrane also will be thickened, and at a late stage of the affection, expanded from effusion; the ligaments in this way becoming elongated and the joint dislocated. Adams's "additamentary bones" or new plates of bone of different sizes are found within the synovial membrane, with probably some pedunculated bodies upon its inner surface.

In the knee-joint.

Additamentary bones.

Early symptoms.

In its early stage, the disease is characterised by local pain, stiffness or rigidity of the joint, and local thickening and development of bony outgrowths, every movement of the joint giving rise to a characteristic crackling. In the later stage, the same pain manifests itself with thickening, bony outgrowths, effusion, greater mobility, and even dislocation, and finally, disorganization.

I have a lady under observation in whom this disease is so developed in both knee-joints that the legs are as flails, the bones being enormously expanded and the joints distended, additamentary bones and osteophytes existing. She can only stand by means of artificial supports.

Treatment of osteo-arthritis.

TREATMENT.—Little can be done by means of medicine to check the progress of this affection beyond attention to the general condition of the patient. In the iodide of potassium we possess a drug that certainly relieves pain, and also I believe retards the progress of the disease, the liquid extract of bark or other tonic being a valuable adjunct. When pain is severe, anodynes may be given, such as Dover's powder, or the bromide of potassium in doses of gr. x or gr. xv, this drug going well with the iodide. Professor Smith, who has paid so much attention to this disease, thinks well of an electuary of guaiacum, sulphur, the bitartrate and carbonate of potash, ginger, and rhubarb. Dr. Adams prescribes the diluted phosphoric acid. Warm bathing is of use, as are also the mineral springs of Germany. This disease, although locally a painful one, does not appear to have a fatal tendency, and unless very neglected rarely goes on to the disorganization of the joint. To maintain rest is not a recommendation to be attended to, as it tends to make the joint stiffen in the early stage of the affection without arresting its progress. In the more advanced stage when "hydrops articuli" is present, and the ligaments are so loose as to allow of the displacement of the joint, some mechanical appliance is called for, such as that afforded by simple strapping, or of some firm leather, felt, or other casing. In extreme cases excision or amputation may be required.

When hydrops articuli is present.

Joint Disease associated with Nervous Affections.

Charcot's disease.

It has been known for some years that joint affections which simulate those called rheumatic have been met with in the subjects of diseases of the nerve centres as well as in those who have had injuries to large nerve trunks. Indeed, from a recognition of this connection, Dr. J. K. Mitchell, of Philadelphia, in 1831, originated the theory that rheumatism was a spinal neurosis ('Amer. Journ. of Med. Science,' vol. viii)., and his argument had something in it. At the present day attention has been more particularly drawn to the connection by Charcot, Weir Mitchell, Clifford Allbutt, Buzzard, and others, and abundant evidence has been published to prove that in *tabes dorsalis* or *locomotor ataxia* there is a peculiar joint affection which approaches in some of its characters the osteo-arthritis just described, and yet, in others, differs from it in a very marked manner.

Symptoms.

It may appear early in the progress of the nerve disease, that is with the characteristic "lightning pains," or it may not show itself till these pains have become well marked. It usually first shows itself in one of the joints of the lower extremity.

The joint trouble begins with effusion into the joint, some swelling of the limb, and crackling of the joint on movement; but with these symptoms there is usually no increase in the temperature of the part, no pain, and no constitutional disturbances.

These symptoms may last for a few days or weeks and then disappear, and either leave nothing behind except some crackling of the articulation, or a joint deformed from relaxation of its ligaments or even dislocated. In extreme cases an articular facet of bone becomes worn away and the head of the bone so altered in shape as to be unrecognisable. There may be false bodies to the joint, and in some cases osteophytic outgrowths from the articular surfaces, but these are never so well marked as they are in osteo-arthritis. There is never in this affection any eburnation of the articular surface of bone so constant in osteo-arthritis.

At the same time there is a strong analogy between the two affections, and I am disposed to think that the differences between the two classes of cases is to be explained more by the fact that in the case of osteo-arthritis the disease invades tissues in which nerve influence has its normal power, whereas in the other there is clearly a deficiency of such power.

In osteo-arthritis there is more new bone thrown out in the shape of osteophytes and plates than in the arthropathy of nervous disorders, because the action in the part is of a more sthenic type, and for the same reason in the arthropathies now under consideration, the bone, from being ill-nourished and containing a diminished quantity of phosphate of lime and an excess of fat, is more readily worn down by attrition and made to disappear than in the osteo-arthritis of the more sthenic kind in which the bone from its hardness becomes eburnated and is only slowly ground down by attrition. More knowledge is, however, required respecting both these affections before they can find their right place in pathology.

TREATMENT.—Little more can be done in these cases than keep the joint quiet by means of splints, and so prevent movement, attrition, and displacement. In the state of joint effusion well-applied pressure is of use, and that applied by means of an elastic or rubber bandage over cotton wool is to be recommended. When dislocation exists, some immovable casing to the joint is of use.

ACUTE BURSITIS AND SUPPURATION AROUND JOINTS.

Acute bursitis and acute suppuration around joints.

I have placed these two headings together, as there is good reason to believe that suppuration about the cellular tissue external to a joint is most frequently the consequence of an acute inflammation of some superficial bursa, and that it is only in exceptional instances such a connection cannot be traced. Over the knee- and elbow-joints, where this suppuration is generally met with, some blow, fall, or punctured wound may originate an acute inflammation in the bursæ of these parts, while the thick integument covering them prevents the inflammatory products making their escape externally, and favours their lateral extension: the abscess consequently in one case, after covering the knee, burrows backwards into the popliteal space, or in the other comes forwards in the arm into its flexure; more commonly, however, it shows itself as a painful phlegmonous inflammation over and around the patella or olecranon process. In some examples, the suppuration is confined to the bursa, while in most, the inflammation will be found to radiate from these well-known points. In children, however, the connection between the suppuration and bursitis is not so readily made out, and there can be little doubt that at times it does not exist.

Situation.

Cases in which suppuration around joint most frequent.

The severe cases of suppuration around a joint are most frequently met with in children of delicate and feeble frames, and in the badly fed, who are disposed to rapid extension of suppurative inflammation when started by any slight accident, blow, fall, or strain. When these large abscesses appear around the shoulder—a joint that is less liable to disease than any other—it has probably been caused by some strain or injury, when the child is dragged along by a careless or violent companion; or, it may be that the muscles of the parts are injured. At times, it is the epiphysial cartilage placed between the epiphysis and the shaft of the humerus which has suffered.

On diagnosis.

The diagnosis of these cases of suppuration external to the joint is not difficult. On examination it will be seen, that the swelling is external to the joint, covering in the well-known points of bone; in the knee, the soft parts probably will be raised from the patella, and fluctuation will be felt above and around it. There will be much local pain, but not so much constitutional disturbance as would exist with a suppurating joint; the joint, moreover, will be capable of some amount of movement without pain, a condition which would be impossible if the seat of the disease were in and not around it.

Treatment by free incision.

Treatment.—There is only one form of treatment on which reliance can be placed in these cases, and which consists in giving free exit to the pus. A free incision, consequently, should be made into the abscess over the seat of the bursa as soon as any pus can be detected. The limb should be raised, the joint preserved at rest by splints, and warm-water dressing or a poultice applied, and the joint should be kept absolutely quiet till repair has been completed. When the powers of the patient are feeble, tonics should be given. When the abscess is not opened early, it may open into the joint and produce an acute suppuration. I have known this happen in the knee with a fatal result. In the knee it is often necessary to make a free incision on either side of the joint as well as over the patella in order to prevent burrowing.

CHAPTER XXXIII.

DISEASES OF THE BONES.

On diseases of bone.

General remarks.

In a pathological sense, diseases of the bone are identical with those of other tissues, while such differences as exist are due to their anatomical and physiological peculiarities: diseased action, under all circumstances, being materially modified by texture. In the bones, diseased action is thus modified by the presence of the inorganic material which they contain, two thirds of their constituents being earthy, and one third animal. This animal texture includes a fibrous periosteal membrane with cellular tissue beneath, as well as a finer endosteal membrane which lines the medullary canal. These two membranes are intimately connected together by delicate vascular and membranous links permeating the Haversian canals and canaliculi of the bone itself. The *exterior* of the bone is dense, and derives most of its nourishment from vessels ramifying in the periosteum. The *interior* of the bone is porous or cancellated, and derives its supply of blood from a distinct nutrient artery which runs in the endosteum, while the capillaries of both anastomose freely through the bone canals. The long bones also are built up of shafts (diaphyses) and epiphyses; the epiphyses being distinct from the shafts during the early years of life, and having their own vascular supply. The shafts and epiphyses are connected together by means of a layer of epiphysial cartilage, through which, as proved by Professor Humphry, the shafts mainly grow, though interstitial expansion has an influence in bone as in other parts. The epiphyses themselves are covered with articular cartilage that derives its nutritive supply from them. These anatomical points thus briefly sketched, are important to remember when the pathological are considered, as most of the peculiarities of bone disease are explicable by them. Thus, when a bone is inflamed, it can only be so through its soft tissues, its inorganic matter being affected secondarily. The periosteal and endosteal membranes being intimately connected, inflammation originating in one is very liable to extend to the other, and in proportion to the nature or amount of this extension will the inflammation be periosteal or endosteal, and the affection either periostitis or ostitis.

Structure of bone.

Condition of the long bones.

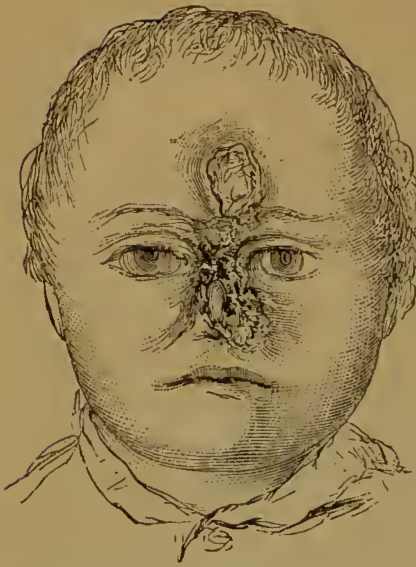
Seat of inflammation in bone.

In long bones when disease attacks the shaft, it may become arrested by the epiphysis or epiphysial cartilage, the articular ends of the bones, and, consequently, the joints escaping. In periostitis, however, such a result is not always secured, for the synovial membrane of a joint, in a clinical point of view, may be regarded as a continuation of the periosteum, and pus beneath this membrane may burrow into the neighbouring articulation, or, the inflammation may spread by continuity. When the disease attacks the epiphysis the inflammation may spread into the joint.

Epiphysitis.

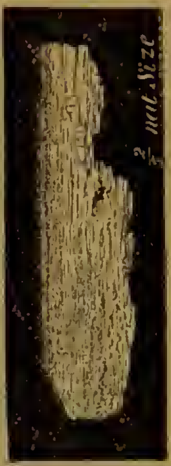
With these remarks, the diseases of bones may be considered, dividing them into the inflammatory affections; tumours of bone; atrophy, hypertrophy, rickets, and mollities ossium

FIG. 569.



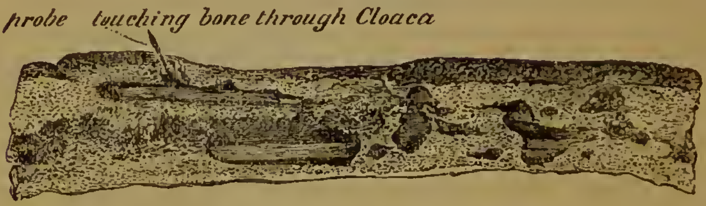
Superficial necrosis of frontal bone following wound caused by the gnawing of a ferret. Delsey, W—, æt. 7 months, June, 1874.

FIG. 570.



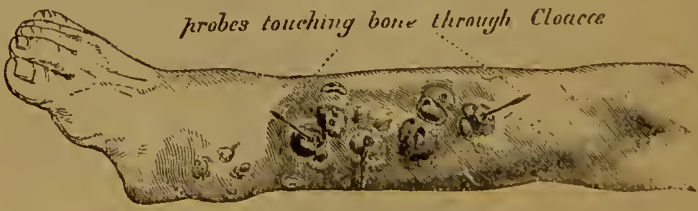
Shell of bone exfoliated as a result of acute periostitis. (Periosteal necrosis.)

FIG. 571.



Death of bone the result of acute ostitis, the sequestrum composed of the shaft of the tibia being surrounded by shell of new bone.

FIG. 572.



External appearance of limb, the seat of acute necrosis of the shaft of the tibia with cloacæ leading down to dead bone.

INFLAMMATION OF BONE

Inflammation of bone.

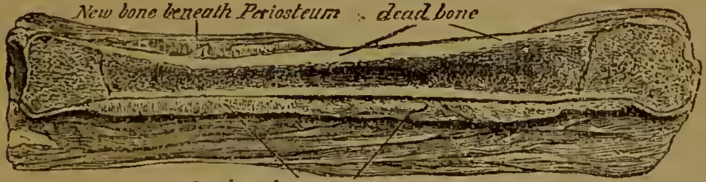
may be divided into the "*acute*" and "*chronic.*"

Acute form.

The *acute* may be idiopathic, or the result of some injury, the division of a bone by operation or a compound fracture: it may end in local abscess of bone, in diffused suppuration, or the more or less complete death of the bone. When originating in the periosteum and not wholly involving the endosteum or medullary membrane, the outer surface of the bone may alone die; when originating in the endosteum and not wholly involving the periosteum, the inner portion of the bone may die and the shell escape; the whole bone dying when both membranes have been equally involved, whether commencing in one or the other. The extent and depth of the destruction of bone, or its "necrosis," is determined by the extent and intensity of the inflammatory action and the degree in which the membranes covering and lining the bone have been involved. Thus on the one hand, the superficial necrosis of the frontal bone of a child may ensue after its exposure from a lacerated wound caused by the gnawing of a ferret (*vide* Fig. 569), in another case a large thin shell of bone may exfoliate from the tibia after an acute periostitis (Fig. 570), in both of these cases the life of the bone having been sacrificed through the death of the periosteum alone. Fig. 571 represents a sequestrum, the result of an acute endostitis, osteomyelitis or ostitis (for all these terms are synonymous) surrounded by a reparative shell of bone newly formed by the uninjured periosteum; while Fig. 572 illustrates the appearance of the limb so affected, taken from life, with the sinuses open leading from the surface of the limb through the soft parts of the shell of new bone to the sequestrum. Fig. 573 represents a section of a bone which died, nearly as a whole, from inflammation of both membranes, and upon the upper surface of which no new bone formed, the periosteum having been completely destroyed; although at the lower part, where the membrane was sound, bone has been renewed.

Death of bone from inflammation.

FIG. 573.

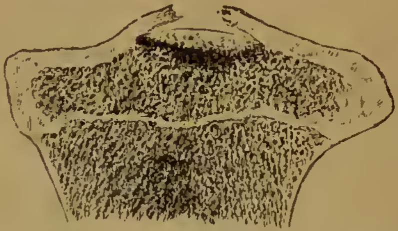


Necrosis of the shaft of the tibia, the result of acute ostitis and periostitis. Prep. 1243^{65}.

In all these cases the inflamed bone died wholly or in part from an acute inflammation,—the bone by the inflammation having been deprived of its vascular supply through a blocking of its capillaries, its death resulting from blood stasis. These changes, however, do not always ensue, for the acute inflammation in some cases may terminate in an acute abscess of bone with or without necrosis, and in other cases in acute abscesses. I have in the tibia met with three centres of suppuration the result of acute inflammation. When acute inflammation attacks an epiphysis the same pathological changes ensue. The whole epiphysis may die and be cast off, or may be the seat of an abscess, or of a local necrosis, and when the local necrosis is confined to the articular lamella of bone, the joint will become involved as well illustrated in Fig. 574. In Fig. 562A the head and neck of the radius necrosed and gave rise to suppuration.

In chronic inflammation of the articular extremities of the long or spongy bones, other changes occur. They may be described as follows, quoting my own words, written in 1859 (on diseases of joints):—In the earliest condition, simple vascularity will be the principal morbid appearance, the cancelli containing more serum than natural; but as the disease advances the bone becomes larger than natural, this enlargement, in some cases, being very great. Upon making a section of the bone, the saw will break through its structure more easily than in a healthy specimen, its earthy constituents having diminished; and on comparing the structure of the diseased with a healthy bone it will be observed that its cancelli are much enlarged, and the columns radiate from the shaft in a palm-like fashion, as if they had been spread out from downward pressure. When the inflammatory process is of a tolerably healthy character, parts of the bone will appear denser and more indurated than the remainder, from the organization of the inflammatory deposit, this deposit in bone always becoming osseous; frequently, however, the death of the bone, with a small or large sequestrum, or a local or diffused abscess, is the result. If the denser portion of bone forming the shell is examined, it will be found thinner than natural, and appear as if it had been dilated, in some cases crackling on firm pressure. Where the articular extremity joins the shaft some new bone may be detected, thrown out as it were to support its dilated body. The articulating surfaces of the bones will in some parts appear more vascular than normal; whilst in other more advanced cases, portions having been thrown off like a slough, will be found loose and lying in the joint, the denser portions of bone, as a result of articular ostitis, dying more rapidly than the cancellated.

FIG. 574.



Necrosis of the articular lamella of bone, with degeneration of cartilage covering it in.

Chronic changes bone undergoes in inflammation.

Comparison of diseased and healthy bone.

Affection of cartilages and extension to joint.

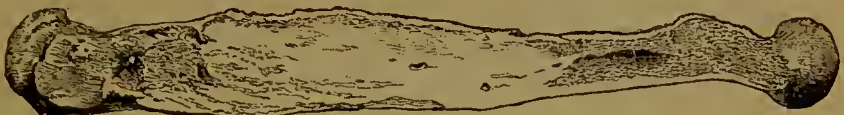
The cartilages at the same time undergo degenerative changes and separate from their bony attachments more or less rapidly, in some cases being cast off as a slough, or shed as a nail or cuticle. Under these circumstances joint disease occurs.

In chronic inflammation of the shafts of bones, changes similar to these are equally manifest, the bone in the early stage first expanding, and, in subjects of better power subsequently thickening from the organization of the inflammatory exudation, the bones thus becoming solid and dense, and the subject of a condition known as sclerosis (Fig. 575).

Subperiosteal deposition.

In cases of inflammation of bone when the periosteum is not morbidly involved, a layer of new tissue secreted from the periosteum is poured out upon the bone, which at first is soft and fibrinous, and subsequently hard and osseous, this new material being reparative in its nature, and that from which the new bone will be formed. It may be only a few lines in thickness, though at times it is even half an inch (Fig. 577); and before it becomes osseous, it can readily be peeled off the bone by means of the handle of a scalpel or a periosteal elevator. It is to this tissue M. Ollier alludes, when he recommends the sub-periosteal resection of the shaft or articular ends of bone, for it is upon such mainly that the regeneration of a bone or part of a bone depends. Changes analogous to those described as going on in the periosteum occur in the endosteum or medullary membrane of the bones, although not so well seen. The products, therefore, of a periostitis or endostitis vary with the character and intensity of the inflammatory process, precisely in the same way and under the same conditions as the products of inflammation vary in the softer tissues. In very intense inflammation, the death of the inflamed part is the result; death of the periosteum with the bone depending upon it for its nourishment, of the endosteum with its bony fabric, or of the whole bone when both membranes are equally involved. When the bone does not die in mass, it may in detail, and as a result of the inflammation local abscess of bone or diffused suppuration may ensue with or without necrosis or a sequestrum; when the suppuration is around the bone it is seen as a periosteal abscess, a condition which is mostly followed by a more or less extensive necrosis.

FIG. 575.



Sclerosis of bone, the result of chronic inflammation. From Prep. Guy's Mus.

Acute necrosis.

Diffused abscess of bone.

Local abscess of bone.

Character of pus as a guide.

The character of the pus in these cases of bone abscess is of diagnostic importance. Pus the result of periostitis differs in no respect from that found in other tissues, but pus the result of endostitis, ostitis, and osteo-myelitis, is mixed freely with oil-globules. In a striking case of this latter affection in a girl, æt. 10, which was under my care, where a free incision was made down to the tibia, the surface of the fluid evacuated was covered with oil cells. Roser has made a like observation.

Acute Inflammation of Bone,

Clinical symptoms of acute inflammation of bone.

whether periosteal or endosteal, is chiefly found during the growing period of bone before puberty, and is a very grave affection. It occurs in the feeble and cachectic, and in those termed scrofulous; in the shafts of the long bones, as well as in the epiphysis, and in such as are most exposed, as the tibia and ulna; although it is almost as frequently seen in the femur. The bones of the upper are probably more rarely affected than those of the lower extremity. It is often the result of some local injury or exposure, though as often as not no such exciting cause can be made out.

Symptoms.

Symptoms.—The disease is generally ushered in with a deep aching pain in the bone with local tenderness, often a rigor, followed by intense constitutional disturbance and increase of temperature. The pain in the limb is speedily followed by swelling, which is at first deeply placed, and not marked by any external evidence of inflammation, such as redness; as the swelling increases, the soft parts covering it become tense and œdematous, and the veins of the part look full, such symptoms indicating deep-seated obstruction, while any attempt at movement or pressure causes suffering. When the disease is situated in the articular end of a bone it is constantly mistaken for rheumatic fever.

When periosteal.

When endosteal.

If the disease is "*periosteal*" in its origin, the skin soon becomes involved and local redness appears, the slightest touch exciting pain. If "*endosteal,*" at the onset, gentle manipulation will be allowed, and many days will pass before redness and other external signs of inflammation show themselves, these appearing only when the disease has spread to the periosteum, and through it to the soft parts around.

When suppuration ensues.

When suppuration ensues, the skin, from being tense and œdematous, becomes inflamed, and the constitutional disturbance worse; rigors become more frequent, pain is more intense; sleeplessness and probably delirium with a feeble pulse appear; and unless relief be afforded by a free incision down to the bone, death by exhaustion and probably by blood-poisoning is apt to occur; since the connection between acute inflammation of bone and septicæmia is very close (*vide* Chapter I).

When the inflammation is essentially *periosteal* more or less well-formed pus mixed with blood will be effused; though in feeble subjects it may be only a blood-stained serum containing lymph. In some of the worst cases of this disease I have seen, this effusion was very copious.

Endostitis is particularly prone to be accompanied by blood-poisoning; it is, therefore, a far more serious disease than periostitis, whether as a primary affection or consequent upon the latter.

Acute inflammation attacking cranial, carpal, and tarsal bones, &c.

Acute periostitis, ostitis, or endostitis, may attack the cranial, carpal, and tarsal bones, the shafts, articular ends of bones, or epiphyses; and, according to its seat or extent, it may terminate in recovery or in the complete death of either the centre or shell of bone. The best instance of death of the bone from periosteal inflammation is seen in the ungual phalanx of the finger, the bone dying as a whole some five or six weeks after the first onset of the inflammation, without any attempt at its re-formation. Such cases are generally, but wrongly, looked upon as *whitlows.* Of the tarsal bones, it is most common in the os calcis, large sequestra being often met with in this bone; periosteal necrosis is, however, comparatively rare in the calcis, except as a result of injury to its tuberosity.

When attacking articular end of bones.

When this disease attacks the articular ends of the bones, acute joint mischief is the general result, and when it follows the division of bone, either by amputation, re-section, or after compound fracture, gunshot or otherwise, it is a common cause of death, and too frequently is the precursor of septicæmia. Sir Joseph Fayrer, who has drawn attention to this fact in his 'Annals of Med. Science,' 1865, looks upon the prominent fungous mass of granulations that is often seen covering the end of an amputated bone as indicative of the affection, and believes that the facility with which the Surgeon passes a probe well into the medullary cavity through these granulations establishes the diagnosis. He gives the general symptoms as pain in the part, œdema, and swelling extending down the limb, general fever, with quick pulse and increased temperature, and more especially the recession of the soft parts, including the periosteum, from the bone, which is then left denuded at the bottom of the wound.

Jules Roux, of Toulon, first drew attention to this affection, and gave it the name osteo-myelite. It is, however, essentially an endostitis, only of traumatic origin.

Treatment of acute inflammation of bones.

Treatment.—In all cases of acute inflammation of bone or periosteum, in which of necessity there must be effusion beneath the dense fibrous periosteal layer, there is no treatment equal to that of a free incision down to the bone; and if the disease is not arrested or modified by this practice immense relief to pain is rapidly afforded. There is good reason to believe, too, that by such treatment the disease is often limited and even arrested, as well as the death of the bone averted; for bone, like other tissue, is very prone to die when subjected to the compressing influence of a confined effusion. When the upper part of the shaft or the articular end of a bone is the seat of disease, this practice is very important.

Importance of free incision.

Example.

Before making an incision there is no need for the Surgeon to wait for the formation of pus, as to do this is generally to wait too long; the object of the incision is to relieve tension, consequently it should be carried out as soon as tension clearly exists. In cases of acute disease of the tibia, with severe local pain and constitutional disturbance, I have opened the periosteum on the third or fourth day, before any external evidences of inflammation showed themselves, except turgid veins and bone enlargement. The incision gave vent to blood-stained serum, but it was followed by immediate relief to all local and constitutional disturbance, and to a rapid recovery. If the incision does not save the life of the bone, it relieves symptoms, and, what is more, it may limit the disease by preventing the pus from burrowing beneath the periosteum covering the shaft of the bone into the neighbouring joint. This liability to joint complication is, indeed, one of the strongest arguments in favour of the practice. The limb, at the same time, should be elevated, and hot fomentations applied; pain should be relieved by opium, morphia, chloral, or any other sedative, and the general powers kept up by abundance of nutritious food, such as milk; while stimulants should be cautiously administered.

General treatment.

When ending in necrosis.

When the inflammation ends in necrosis it requires to be treated according to the mode to be referred to in a later page.

Occasionally, as an effect of acute inflammation of the periosteum, much blood is effused between the membrane and the bone. I believe this result to be mechanical, and due to the rapid separation of the periosteum; it is only met with in acute cases.

Acute Abscess in Bone.

Abscess in bone.

Abscess in bone is the result of a local inflammation, and may or may not be associated with the death of a small piece of bone. In some cases it is acute, but more generally chronic.

In the *acute* some necrosis is generally associated with it; in the *chronic* such an association is more rare.

Example of acute abscess of bone.

Not long ago I treated a boy, æt. 17, who, after intense pain in the head of his tibia for three days, had local swelling and severe constitutional disturbance, that had been regarded as due to rheumatism At the end of a month, when I saw him, I made a free incision down to the bone to relieve pain, and give vent to any pus that might have found its way externally. A week later pus appeared evidently from the bone, for a probe could be passed through the wound into a cavity. Two weeks later, or six weeks from the commencement of the symptoms, I enlarged my opening, and through the aperture in the head of the bone from which the pus had flowed I removed three pieces of bone, together making one the size of a nut, which rested in a cavity lined with velvety granulations, such as are so characteristic of an abscess. A complete recovery ensued. In another boy, æt. 16, in which severe local and constitutional symptoms had arisen early, I removed a similar piece of bone from a like cavity in the end of the radius, and with a similar good result. In both cases acute inflammation of bone had ended in the formation of a local abscess with circumscribed necrosis, and recovery rapidly followed the surgical treatment.

Local abscess in end of radius.

Abscess in head of tibia.

A few years ago a child was brought to me who had received, when asleep, an injury to the tibia, from a playfellow having attempted to drive a pin into the bone. Nothing beyond some slight local pain had followed the injury for a few days, when severe pain and swelling appeared, with fever, &c. I cut down upon the part with a view of giving relief, when the point of my knife went with a crackle through a thin layer of bone into a cavity, which gave vent to a teaspoonful or more of pus. Immediate relief followed the operation, and a good recovery took place.

These three cases suffice to illustrate the fact that acute abscess in bone is met with, and to show its symptoms and treatment.

Chronic Abscess in Bone.

Chronic abscess in bones.

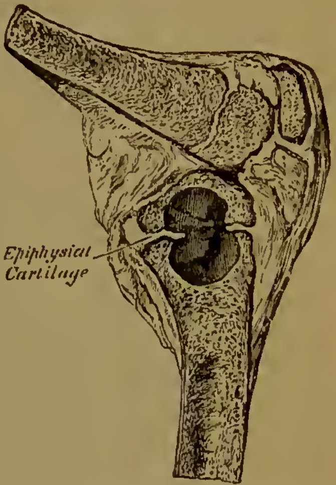
In 1773 William Broomfield, Surgeon to St. George's Hospital, in his 'Chirurgical Observations,' writes:—"Whenever a patient complains of a dull, heavy pain, deeply situated in the bone, possibly consequent to a violent blow received in the part some time before, and though at the time the patient complains of this uneasiness within the bone, the integuments shall appear perfectly sound, and the bone itself not in the least injured, *we have great reason to suspect an abscess in the medulla.*" In 1824, Sir B. Brodie amputated a limb for incurable pain in the tibia, and in this case, which Sir W. Fergusson has described "as one of the beacon lights of surgery never to be forgotten;" "the lower end of the tibia is enlarged, and the surface presents marks of great vascularity; the bone in the preparation is divided longitudinally, and just above the articulating surface there is a cavity as large as a small chestnut. This cavity was filled with dark-coloured pus. The inner surface of it is smooth. The bone immediately surrounding it is harder than natural."

'College Lectures,' 1867, p. 35.

In these two extracts, written at an interval of fifty years, are embodied the clinical and pathological facts connected with this subject which are now recognised by Surgeons.

Sir B. Brodie in 1846 published a valuable paper on this subject, and to him, oddly enough, the full credit of recognising these cases has been wrongly attributed. He probably first heard of them from John Hunter.

Fig. 576.



Abscess in head of tibia, followed by disorganization and dislocation of the joint. Prep. Guy's Hosp. Mus, 1245^{50}.

Situation.

This chronic abscess is generally met with in the articular ends of bones; that is, in their cancellous tissue, more particularly in the two ends of the tibia. I have, however, seen it in the condyle of the femur and the humerus, and in the shafts of the ulna, radius, and tibia. It may also occur in any bone. In Fig. 576 the cavity of such an abscess is illustrated, and in Fig. 559 is seen its opening into the joint. The history of these cases is generally obscure, an injury at times being its assigned cause. The most characteristic symptoms are a fixed, aching pain in the part, "the pain being a dull one, rather tending to produce sickness than to rouse" (John Hunter); exacerbations occur in its progress, when the pain becomes acute, fixed, and of a burning pulsative kind, "like the falling of drops of molten lead," as a patient once described it to me; there will likewise be local circumscribed tenderness or pain on firm pressure, with probably some evident enlargement of bone, and the sense of local heat.

Symptoms.

Œdema.

May open into joint.

In more advanced cases, the soft parts over the bone will be œdematous, and on firm pressure over the painful spot, a sensation of yielding will be given to the finger. In still more neglected cases, the abscess may make its way into a joint; while under fortunate circumstances it may advance forward and discharge itself externally.

Treatment.

Opening by the trephine.

Treatment.—"Abscess in bone may find its way to the surface," but "the crown of the trephine is often necessary in order to get at the seat of abscess," said John Hunter, in 1787 (M.S. lec.). At the present day a like treatment is to be advised, as nothing less than the opening of the abscess in the bone is of any use, and this is usually done by means of a small trephine. The point to be selected for the operation is the painful spot, which should be marked before the patient is anæstheticised; the soft parts should then be divided by a crucial incision and turned back, and the bone itself freely perforated, with the periosteum covering it. When the instrument has opened the abscess, pus will well up at once; the ring of bone raised by the elevator ought then to be taken away; the cavity, which is generally lined with smooth velvety granulations, is rarely very large, and the quantity of pus seldom above a drachm, although sometimes there may be more. After the operation the parts have only to be left alone to heal, recovery being very general.

Puncture with drill.

Cases.

It is not always necessary, however, to trephine a bone, as a less severe operation is at times all that is required, and that is, its simple puncture by means of a drill; when the seat of the abscess is not very accurately defined the drill is probably the better instrument to use. In a striking case I had in the spring of 1870 I carried out this operation and punctured the head of the tibia of a man who had all the external evidence of local ostitis and suppuration, such as pain, bone expansion, &c. I cut down upon the painful expanded part, and made two punctures with a drill, one of which clearly went into a cavity in the bone, as evinced by the sudden loss of resistance. No pus, however, was seen to well up in the wound at the time, though soon after the operation a free discharge took place. The operation was followed by complete relief from all pain, and in a month the man left Guy's quite restored, and three months later he remained so. More recently, I arrested disease in the femur of a boy, æt. 18, by trephining the trochanter major and puncturing the bone with a drill through the opening.

Value of drilling.

This operation of drilling the bone seems to be good either for supposed suppuration or chronic ostitis. It is less formidable than trephining, and may be done in cases where the latter is inapplicable or not to be entertained; indeed, the two means may be employed together when the trephine has failed to open the abscess. Holmes's suggestion is good, viz. to pierce the walls of the trephine-hole in several directions with a sharp-pointed instrument, in order to remove the bone freely with a chisel, if a drop of pus follow any of these punctures.

Chronic Periostitis and Endostitis.

Chronic periostitis.

Periosteal effusion.

Sclerous.

Chronic *periostitis* and *ostitis* are very common affections, more particularly involving the shafts of the long bones. These affections may be modified by syphilis, scrofula, or rheumatism, and may originate from some local cause or injury, but in all, their course is the same; the disease varying only in the rapidity of its progress, extent of its influence, and results. In one case, complete recovery may take place, the effusion being re-absorbed; in another, the effusion may become organised as a superficial node or bony outgrowth (Fig. 577), or, as an enlarged, elongated area of dense bone (Fig. 575). In exceptional cases, local suppuration may occur, giving rise to a chronic periosteal or endosteal abscess; in a large proportion of instances the bone dies and thus gives rise to local *necrosis;* whilst in some few, the bone, either upon its surface or interior, undergoes a chronic disintegrating process known as *caries*.

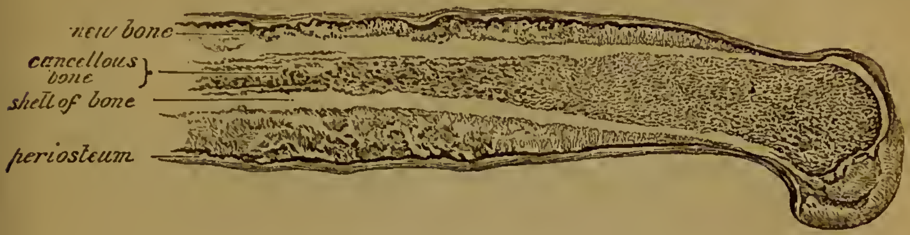
In local periostitis a small portion of bone alone may die, and, as Sir

James Paget has shown ('Clin. Soc. Trans.,' 1870), remain quiescent under a puffy or suppurating swelling.

Symptoms.

Symptoms.—The symptoms of chronic periostitis and ostitis (endostitis) are in their nature very similar to, though less severe than those of the acute, the most constant being a dull, aching pain in the part of a persistent kind, aggravated at intervals, and on hanging down the limb; the pain being almost always worse at night, more particularly in syphilitic affections. The constitutional symptoms vary according to the severity of the local condition, febrile disturbance, and intensity of local action running hand in hand.

FIG. 577.



Effects of periostitis.

Pain.

Difference in symptoms between periostitis and endostitis.

As regards enlargement of bone.

As regards suppuration.

In *periostitis*, the pain is generally local and attended with swelling at an early period of the affection, indeed, within a few days of its onset. In *endostitis*, the pain is generally more diffused through the whole bone, and will continue for weeks or months without any external evidence of enlargement, being too often regarded as "rheumatic" or "growing pains." In *periostitis*, tenderness on manipulation is an early and constant symptom. In *endostitis*, the bone may be manipulated with gentleness without exciting pain; firm pressure, however, almost always causes suffering. In *periostitis*, the enlargement generally shows itself as a bossy or undulatory swelling on the surface of the bone, with one, two, or more nodes, upon the bone; syphilitic periostitis is generally multiple and undulatory, traumatic and other forms of nodes usually single. In *endostitis*, the enlargement appears as a general expansion of the bone in all directions; in rare cases as a distinct *elongation*. In *periostitis*, when suppuration is about to take place, external evidence will appear in the form of increased swelling and tenderness, while redness of the skin, œdema of the tissues covering in the node, and fluctuation will be present. In *endostitis*, terminating in abscess, there will be a great aggravation of local pain with constitutional disturbance, and often rigors; and, when œdema of the soft parts over the bone and external evidence of inflammation appear, the abscess is making its way externally through the periosteum (*vide* Abscess in Bone).

In necrosis of a long bone the result of periostitis and endostitis by extension, the hope of a new bone being formed is forlorn, as the periosteum—the chief bone-forming membrane—has been destroyed; while in the necrosis of endostitis, there is every hope of a complete restoration of the bone through its periosteal covering taking place, on the removal of the dead portion or sequestrum.

In the *necrosis of the skull*, which is always periosteal, no new bone is formed, as the periosteum is destroyed. When following an injury to the skull it is preceded by "the puffy tumour of Pott." In syphilis it follows a suppurating node.

Sequestrum within sequestrum.

In a rare, if not unique preparation (Guy's Museum) of necrosis after amputation, taken from a patient of my own, the end of the divided femur died, and, at a later period, the periosteal sheath of new bone that formed around it also died, one sequestrum being found within the other on their withdrawal from the stump.

Treatment where no suppuration.

Treatment.—In *chronic periostitis* when suppuration does not take place, fomentations, with the elevation of the limb, sedatives to allay pain, and the internal use of the iodide or bromide of potassium, with or without tonics, according to the special requirements of the patient, are the most efficient means. In still more chronic cases, the use of a blister, or the repeated application of the compound tincture of iodine, is of value. If rheumatism seem to influence the morbid action, colchicum has a beneficial tendency. When nocturnal pain is great, besides the internal administration of opium or other sedatives, the external application of belladonna certainly gives relief. When pain is severe and unrelieved by such treatment, a subcutaneous section of the periosteum with a tenotomy knife is advisable.

Where suppuration.

When suppuration threatens, the warmth of a poultice or hot fomentation with or without the application of leeches may sometimes arrest it; a blister at times also seems to check its progress. When pus has formed it is wise as a rule to let it out, but the Surgeon should be in no hurry to do this unless the pain is great and the abscess has a disposition to spread, as pus may be re-absorbed, and opening a periosteal abscess renders bone exfoliation more probable.

Treatment of chronic ostitis.

Chronic ostitis is an affection most troublesome to treat with any effect, and the same means that have been recommended for periostitis may be tried in this. In a general way, however, they do little more than give relief, and have but slight effect on the progress of the disease, it being far too common for a bone in a state of chronic inflammation to become necrosed. When treated early, however, success is not unfrequent. When the disease is steadily progressing and remedies appear to have no influence on its progress, the operation of drilling the bone in one or more points according to the extent of the disease, is an operation to be recommended; when this fails, that of trephining may be employed, for if taking away a piece of bone or drilling it does not arrest the disease, which it undoubtedly often does, it at any rate gives relief to local pain. Pain in endostitis or periostitis is due to tension caused by pent-up inflammatory effusion, whether fibrinous, purulent, or serous, and relief can only be afforded by its removal. When a new growth, cystic or otherwise, occupies the centre of a bone, a like pain is, however, experienced.

Drilling.

Trephining.

Necrosis

On necrosis.

means the death of bone, and it is as a rule the result of an acute periostitis or endostitis; the chronic action being shown in the process of exfoliation, *i. e.* in the separation of the dead from the living bone; for in this process, a considerable time is often expended, no definite period having been hitherto recognised, as the rate of progress differs in every case. It may be of the shaft of a bone or of an epiphysis; it may be of the shell or compact tissue, of the inside or cancellous tissue, or of both combined. It may occur idiopathically without known cause, or as the

Causes.

result of fever, injury from sprain, concussion, contusion, fracture, or gunshot wound. I have already related a case in which local necrosis of the articular extremity of the tibia took place in six weeks, and it is well known that phalanges necrose and exfoliate in five or six; in fact, in acute necrosis, a month or six weeks is full time for bone to die and be thrown off. This process is, however, at times very chronic. In the necrosis of the lower jaw from phosphorus, the same truth is exemplified.

Process of exfoliation.

The process of exfoliation is a very beautiful one, and is the same in bone as in the soft parts, only slower.

Holmes's description.

"When a portion of bone is to die," writes Holmes in an admirable article in his 'System,' vol. ii, 3rd ed., p. 294, "the first phenomena is the cessation of circulation in it. This leaves it hard, white, and sonorous when struck. It does not bleed when exposed or cut into, and is insensible. Occasionally, when the dead bone is exposed to the air, and acted on by the presence of putrid pus, its colour becomes nearly or quite black; large surfaces of hard, black, necrosed bone are sometimes left exposed by the sloughing of the skin over the tibia. The dead bone at first retains its connection to the bone around, as well as to the periosteum or whatever part of the nutrient membrane may belong to it; but the presence of a dead part is never long tolerated by the living tissues, and accordingly the processes which are to eliminate it soon become perceptible in both these structures. The periosteum or medullary membrane, as the case may be, separates from the dead bone and becomes inflamed, a quantity of ossific deposit (more or less, according to circumstances) is poured out between it and the dead bone, and this deposit soon becomes converted into new bone, forming a sheath over the dead portion, by which the latter is enclosed or *invaginated,* as the technical term is. The dead part is now called a *sequestrum,* a name only properly applied to it when loose and invaginated, though often incorrectly used of any piece of dead bone. While this sheath is being formed from the membrane coating the dead bone, changes are going on in the living bone to which it was attached. When the latter has been previously diseased, *i.e.* when the necrosis has been of inflammatory origin, the inflammatory deposit which surrounds the sequestrum softens, pus is formed, and a groove of ulceration is produced at the expense of the circle of inflamed bone which forms the margin of the sequestrum. If the surrounding bone has been previously healthy the sequestrum acts as an irritant upon it, setting up first inflammation and thickening to a variable distance, and then ulceration. Thus a groove is traced round the sequestrum, and the formation of the groove is accompanied by suppuration, 'the pus containing much earthy matter from the disintegrated tissue, B. B. Cooper stating 2½ per cent. of phosphate of lime.' The pus formed in the neighbourhood of the dead parts makes its way to the nearest surface, and in so doing interrupts the formation of the periosteal sheath, leaving sinuses or *cloacæ,* passing through this sheath from the sequestrum to the surface of the body, or sometimes into a neighbouring joint or serous cavity. The presence of such sinuses leading through the shell of bone to hard, smooth, sonorous bone at the bottom of the cavity is the distinguishing mark of necrosis" (Fig. 572).

Where the periosteum has been destroyed, no investing sheath of bone will exist to interfere with the separation and casting off of the

Thickening of bone round sequestrum varies.

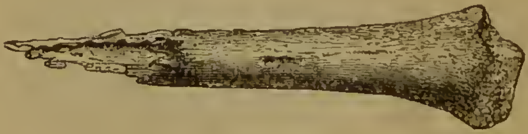
sequestrum (Fig. 573); where it is nearly perfect, the shell of new bone will be complete (Fig. 571). Under these circumstances, the casing thickens and becomes dense. The amount of thickening around the sequestrum depends much upon the extent of new bone poured out by the periosteum and the duration of the process; its density also turns upon the length of time the sequestrum has been invaginated, and the character of the inflammation. The bony shell in its early condition is soft and readily cut, broken down, or peeled off; in its later stages it becomes almost as hard as ivory, and is most difficult to cut. To reach the sequestrum in the thigh, I have cut through a bony sheath upwards of an inch in thickness.

The whole shaft, or any portion of a long bone may become necrosed, the epiphyses often saving the joints (Fig. 573); but as a rule some portion of the shaft remains attached to one or other of the epiphyses. Occasionally the epiphyses themselves are the seat of necrosis. In the tarsal bones during infant life, the ossific centre of the bones may die and exfoliate. There is also good reason to believe that necrosis of the shaft of a bone often originates after a sprain from inflammation started by the injury in the epiphysial cartilage connecting it with the epiphysis. The subperiosteal sheath is never seen in necrosis of the skull or in short cancellous bones.

Cloacæ may be large and allow exit of dead bone.

When the cloacæ of the bone case are large and fortunately placed towards the end of the sequestrum, natural efforts may be sufficient of themselves to get rid of the foreign body, the granulations filling the cavity gradually pressing upon the dead bone, and mechanically extruding it from its bed. In this way, large masses of bone are sometimes discharged by natural processes. After amputation, this result is frequently seen. Some years ago, I saw with Mr. Cock and Dr. Iliff, of Kennington, a case in which the upper part of the shaft of the humerus which had separated at its upper epiphysis, was gradually pressed out from below through the deltoid muscle and projected outside the acromion process for about an inch; Mr. Cock had only to complete the process which nature had so well commenced, and draw out the bone, which was four inches long (Fig. 578).

Fig. 578.



Upper half of the shaft of the humerus thrown off at its junction with the upper epiphysis by natural processes. Prep. 1104^{60}.

Every Surgeon is familiar with a somewhat similar act in other cases where large pieces of bone, and far more frequently small ones, are sometimes discharged by natural processes; but such successful natural efforts are rare in comparison with the failures; surgical art is demanded, as a rule, to assist in a cure.

Repair after removal of sequestrum.

When the dead bone has been shed, the sequestrum extruded by natural efforts or removed by surgical skill, the bone granulates and thus heals. When this process takes place upon its surface, the steps are very visible, and when the sequestrum has been removed from a cavity, the same process goes on, but with it the gradual contraction of the periosteal shell of new bone that surrounds the sequestrum. A bone in this way is reformed and repaired.

Treatment of necrosis.

Treatment.—When the presence of dead bone has been made out, its removal is the only sound practice, since the longer it is left in its cavity the thicker and denser will become the periosteal bony sheath, consequently the probabilities of a natural cure are lessened, and the difficulties of a surgical operation greatly increased. The sequestrum, however, cannot be taken away until it has been thrown off or loosened from the living tissues; although as soon as this result has been effected, the sooner the operation for its removal is performed the better. To interfere too soon before this process has been completed is sometimes injurious, and always futile; to wait too long is simply to add to the difficulties of the case and to postpone recovery. Bones that are not loose may, however, often be detached by a good twist with a pair of forceps, or raised by an elevator.

Removal of sequestrum.

Await its detachment.

When necessary to interfere.

When the dead bone is found to be loose by means of a probe, by being made to move in its sheath, there should be no hesitation on the part of the Surgeon as to interfering; though when this movement cannot be made out, the same treatment may be justifiable, as the sequestrum may be so tightly impacted or shut in by granulations as to be immovable though still separated. Under these circumstances, the history of the case and more particularly the duration of the disease will be of great help as a guide, for if many months have passed since the inflammation that killed the bone set in, the probabilities of the sequestrum being loose are great, as most sequestra are shed in four, five, to ten months. I have seen a sequestrum in acute disease thrown off in six weeks, and have removed a large portion of the shaft of the tibia three months after the first onset of the symptoms; while, on the other hand, the dead bone may be found fixed at a far more distant date than that named. All know that a necrosed phalanx is generally loose and ready for removal at the end of five weeks, and in most cases the Surgeon is justified in performing the operation for necrosis (sequestrotomy) within the year. English Surgeons, as a rule, are disposed to wait till the evidence of the sequestrum being quite loose is clearly marked; whilst many Continental Surgeons, and particularly the German, excise diseased bone within three months of the first manifestation of disease, by what is called a sub-periosteal operation, that is, the peeling off of the periosteum, and the resection of the shaft of inflamed, dying, or dead bone. But in doing this, as nature has not yet indicated the limit to the disease, nor separated the dead from the living bone, much good bone must of necessity be often removed with the diseased, or much of the diseased bone left behind, both of which are undesirable objects. In English practice the cure is often too long postponed and the difficulties of the operation are increased. In the Continental more may be done by operative interference than is needed or less than is required, the new formation of bone by the periosteum at the same time being necessarily interfered with.

Should we wait till it gets quite loose?

Line of practice to be adopted.

The best practice, probably, is to be found between the two, and that is, surgical interference about three to six months after the first appearance of symptoms; in acute disease, and in small and narrow bones early, but in chronic disease, and in large and thick bones late interference.

The Operation of Sequestrotomy.

Sequestrotomy.

Description of operation.

Use of cutting forceps.

There is no operation in surgery more satisfactory than this, as it is usually unattended with danger and followed by complete success. In many cases it is simple, while in others it is complicated, the ingenuity of the Surgeon being often taxed to devise means to carry out the object in view, viz. the removal of the sequestrum. Taking as a type of the affection, the tibia in which the whole shaft or diaphysis is the seat of mischief, many cloacæ, or fistulæ, leading down to the dead bone through the periosteal bony case will probably be present, as is shown in Fig. 572; and with a probe introduced through an opening at one end and a second probe at the other end, the Surgeon may make his incision between the two down to the bone—that is, down to the new case of bone that envelopes the old—and having done this he may peel back the periosteum with a raspatory or periosteal retractor, cut through the new bone that prevents the dead from being seized, by means of cutting pliers or chisel, and thus expose the necrosed shaft. The dead piece may then be seized by a pair of sequestrum forceps, and, where practicable, withdrawn. Should it be too long to extract through the wound, or should the opening in the bony case correspond to its centre, the sequestrum may be divided with a pair of cutting forceps, and its two halves separately removed. At times a good elevator is of use to raise the sequestrum from its bed, or to prise it from its attachment. Occasionally a good deal of the new casing of bone requires removal before the Surgeon can get at the dead portion; and in the femur where the whole shaft is necrosed, the upper part being larger than the lower, it may be necessary to chisel off or remove nearly the whole surface of the new shell of bone to admit of the removal of the sequestrum, it being impossible to withdraw through the lower orifice a piece of bone of larger diameter. In one case, the simple enlargement of one of the cloacæ may be sufficient to enable the Surgeon to seize and remove the bone; while in another, it is necessary to lay two or more cloacæ into one. The operation should be done with as little interference with the soft parts and bony sheath as possible. The object having been obtained, the parts have only to be kept clean, raised, and left alone to fill up and heal, when a good recovery will generally follow. The instruments employed for sequestrotomy are illustrated in Fig. 579. In all cases, Esmarch's elastic tourniquet should be employed to prevent hæmorrhage.

Arrest of growth after removal of dead bone.

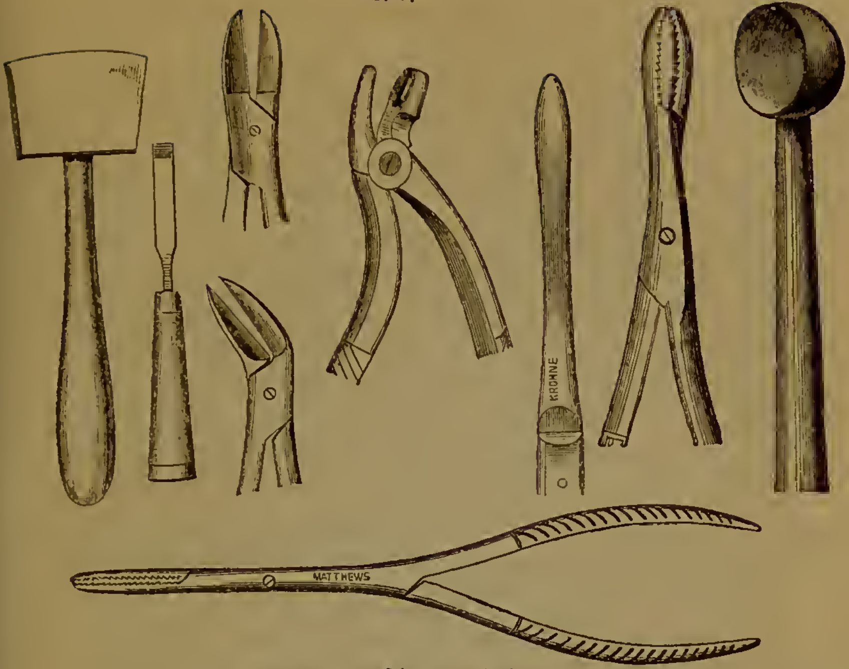
When the whole shaft of a bone has been removed in early life, some shortening of the new bone, or arrest of growth may be looked for, and in the case (Fig. 580) such a result took place. The drawing was taken from a young woman, æt. 25, from whom, at the age of 11, I removed the whole shaft of the tibia. The bowing of the limb was due to the bending of the fibula, which had grown naturally and bent to adapt itself to the shortened tibia.

When the sequestrum cannot be raised from its bed, it had better be left alone, the opening made not being lost, as through it the sequestrum may subsequently be taken away or expelled naturally.

When sequestrum is fixed.

Dead bone, the result of periosteal disease, that is not covered in by new bone, regularly exfoliates, and rarely requires more than its simple removal by forceps, the soft parts covering it being divided; in this way, large portions of the skull may be removed. I have taken away

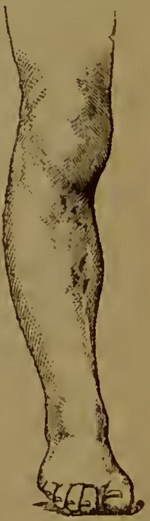
Fig. 579.



Instruments used in sequestrotomy.

nearly half the frontal bone in a child; and also in an adult, after syphilitic periostitis, I have removed large portions of all the cranial bones forming the vault. In one case, large portions of the parietal, occipital, and frontal bones were removed.

Fig. 580.


Necrosis may cause ulceration of artery.

Necrosis producing ulceration of arteries.

Necrosis in a joint.

Arrest of growth of tibia after removal of dead shaft fourteen years before.

When after necrosis of a bone the sequestrum presses upon an artery, fatal hæmorrhage may ensue. Thus, Poland has recorded ('Guy's Hosp. Rep.') three cases where such a result took place in necrosis of the femur, the popliteal artery in each having been wounded. Holmes has also recorded a case where a fatal hæmorrhage from the lingual artery followed disease of the jaw, and in another in which bleeding from the aorta occurred in caries of the spine. A preparation in the Guy's Museum (1243^{30}) also shows a piece of necrosed tibia that perforated the anterior tibial artery and set up hæmorrhage, necessitating the application of a ligature to the femoral artery.

When necrosis occurs in a joint, profuse suppuration and disorganization must ensue. Where this does not prove fatal and repair goes on, recovery may be prevented by the presence of diseased bone; and when this can be detected its removal is the best practice. I have done this in the knee in three cases, and in the hip, ankle, shoulder, and elbow-joints with good result, having in each one removed large pieces of dead bone through a sufficiently large incision ('Lancet,' Feb. 6, 1875.)

Such cases as these must be looked upon as cases of necrosis, the joint having lost its special features by previous disease.

Necrosis of carpal and tarsal bones.

Free incision and removal.

Necrosis of the carpal and tarsal bones is a common affection, for these bones die like the flat bones, no new sheath of bone preventing their exfoliation or removal. They may be treated freely, such incisions being made as will allow of their removal. The os calcis is the bone most commonly affected, and I have removed a large portion of it on many occasions with complete success. The epiphysis of the heel is not rarely affected. The scaphoid is sometimes involved, even at a very early period. The cuneiform and cuboid, separately or together, are also found diseased. Not long ago, I removed from a boy's foot by two incisions, the whole row of these bones, and an excellent foot was left—so good, indeed, that it was difficult to believe that so much bone had been taken away (Fig. 548). The same may be said of the carpal bones. Indeed, in these cases true conservative surgery is of great value. The removal of dead bone, however extensive, is a very safe operation, and followed by results which are often startling by their success. There is no limit to the removal of necrosed bone, wherever found, nor to the amount of natural repair. To amputate a limb, foot, or hand, for necrosed bone until the Surgeon has proved that the removal of the diseased part is impossible, or the simple removal proved unsuccessful, is scarcely a justifiable proceeding.

To gouge away bone that is inflamed and not dead, or to excise inflamed bones that may undergo repair, is a proceeding which is practically bad and scientifically unreasonable; for all bone that is not dead is reparable, and to interfere with it mechanically is bad surgery.

The great success of the operation for necrosis (sequestrotomy) is unquestionably due to the introduction of anæsthetics. Prior to their introduction the operation was difficult and dangerous, indeed, it was rarely performed, amputation having been too often substituted.

Caries.

On caries.

Definition.

No word in surgery has been used with greater carelessness and with a greater variety of meanings than caries, nor is there one that conveys now a less definite idea. In this section it will be applied to an unhealthy inflammation of bone, chiefly of cancellous bone. When superficial it appears as ulceration or molecular death of bone, when deeply placed or central it is often associated with necrosis or suppuration, and may or may not be due to syphilis or struma. It is *pathologically* remediable and reparable, and whenever found is mixed up with reparative processes. In patients of feeble power and some constitutional cachexia, or where the disease is very extensive, it may, however, *clinically* be incurable, and thus require surgical interference. Nevertheless, in its nature it is inflammatory, and should be looked upon as a curable affection, depending more upon constitutional than local causes. In this respect it differs from necrosis.

Periosteal caries.

A bone is said to be *carious on its surface* when being exposed it presents an irregular and worm-eaten appearance, and is suppurating, and the sore throws off a serous, more or less offensive, purulent discharge, which contains excess of phosphate of lime, mixed with small fragments of bone tissue. This affection is generally associated with an ulcer or open sore of the skin over the parts, and more or less thickening of the periosteum and bone around and beneath the diseased portion. It is always vascular, and readily bleeds on being touched. It is occasionally painful. At times the bone is soft and yields to the pressure of the probe, in other cases it is hard. When it attacks the articular surface of a bone it often forms pits with sharp, well-defined edges, and under these circumstances has been looked upon as scrofulous, but with what amount of truth it is difficult to say. When it is associated with syphilis it follows the suppuration of a node. At times it is complicated with the tubercular thickening of the surface of the bone itself, or with what Paget has described as annular ulcers, in which a spot of ulceration is seen which goes on to form a circular trench round a worm-eaten surface. This trench increases in width and depth, and at last loosens a sequestrum, which separates and leaves a circular depression. In bones of the skull this ulcer may involve one or both tables. *This ulcer* may subsequently heal, leaving a permanent depression. "*Caries*," in fact, is inflammation and ulceration of bone, "*necrosis*" is its death *en masse*.

Articular caries.

Syphilitic caries.

A bone carious in its interior is vascular, although softened sometimes almost to rottenness, and easily breaks down; it discharges often a thin, sanguineous, fetid, semi-purulent fluid, which contains fragments and elements of bone; abscesses which generally communicate externally through the soft parts often co-exist in and about the bone, and are occasionally combined with necrosis. In the spine, where it is the more commonly met with, it is often unassociated with any external suppuration or discharge, though the bone with the intervertebral substance softens down and undergoes extensive molecular death; much loss of bone taking place, the particles being apparently reabsorbed and carried away, and complete recovery following without any external discharge. Around the inflamed or carious bone the cancellous tissue is generally infiltrated with more or less organizable inflammatory lymph, the nature of which depends much upon the character of the inflammation. In feeble and strumous subjects the fluid will be of a serous, oily, and non-plastic kind ('Black on Tuberculous Bone,' Edin., 1859), the cancellous bone becoming more cellular and lighter. In more healthy types the effusion will be plastic and organizable, the bone becoming more compact. In one case no consolidation of the surrounding bone will be present, while in another, condensation of the bone to a greater or less extent will be found.

Endosteal caries.

Characters and progress of caries.

Under all circumstances the nature of the inflammatory action turns much upon the constitutional power of the patient; the disease tending in strumous and feeble subjects to widen but not to repair, while in more healthy subjects it inclines to a local action and recovery.

In rare examples, genuine tubercle may co-exist with the inflammation.

TREATMENT.—Looking upon caries as an inflammatory affection, and consequently as curable, it is to be treated on somewhat similar principles as inflammation of other parts. When the general powers of the patient are feeble, they ought to be stimulated by tonic medicine and

Treatment of caries.

In superficial caries.

Pollock's plan.

In deep-seated or endosteal caries. Surgical interference not necessary.

regimen; local pain is to be soothed and torpid action stimulated, but all mechanical and surgical interference should be avoided, except for the removal of dead bone. In superficial caries or ulceration, when rest, elevation, soothing or possibly stimulating applications with tonics, fail to induce a healthy reparative action, local stimulants are sometimes of use, and the local application of such acids as the acetic, nitric, or sulphuric, strong or diluted, has often a beneficial action. Mr. Le Gros-Clark strongly recommends acetic acid as the best solvent of the inorganic constituents. He uses as a dressing one part of Beaufoy's No. 11 acid to five parts of water. George Pollock speaks highly of the value of sulphuric acid, at first diluted with equal parts of water, and subsequently pure, the acid destroying the diseased bone to which it is applied, and setting up a more healthy action in the parts beneath, thus hastening recovery. Boinet advocates the use of iodine, at first diluted, and then strong; others recommend phosphoric acid. Dr. Fitzpatrick applies the Vienna paste or potassa cum calce to the surface of the inflamed bone, as well as to its deeper parts after puncturing them. The actual or galvanic cautery has also been employed, and in superficial caries seems to be valuable. In deep-seated or endosteal caries some speak highly of operative interference, either by the gouging out of the diseased tissue or excision of the inflamed or carious bone; but I allude to this treatment only to condemn it, since I believe it to be both unnecessary and injurious. It is unnecessary, as in the majority of cases recovery can be secured without it; it is injurious, since gouging, as a rule, adds to the irritation, and thus tends to the spread of the disease, and often excites more general inflammation in the bone or endosteum.

Excision not recommended.

Excision of the diseased bone is not an operation that can be highly recommended; yet it may be done, doubtless, with success, as in the tarsus, and many an inflamed or carious os calcis has been successfully excised. There is, however, a strong doubt as to the necessity of the operation. When the bone dies the necrosed bone may and should be removed, but in all other conditions it is reparable under constitutional treatment and local applications. Surgeons who interfere surgically with carious bones usually prefer excision to any partial operation. Superficial or periosteal caries may be regarded and treated as an indolent ulcer in other parts, the repair being more chronic in bones than in soft tissues; deep-seated caries or inflammation may be also considered much in the same light. When syphilis complicates the case, iodine in full doses, in one of its forms, combined with any tonic that may appear to be needed, and as a local application, is of great use.

TUMOURS OF BONE.

Tumours of bone.

Character.

Tumours of bone vary but little in their pathology from tumours of other parts, and whatever differences exist arise from the peculiarity of the tissue in or around which they grow. Tumours of bone, as of soft parts, partake of the nature of the tissue in which they are developed; thus, a tumour that in a fibrous organ would be more or less fibrous, when originating in or upon a bone is mixed with bone, and a carcinomatous tumour of soft parts becomes a malignant osteoid cancer of a bone. In addition to these, there are special tumours known as the myeloid and the cartilaginous.

Varieties of tumours.

Excluding, therefore, enlargements of bone due to inflammation, there are bony outgrowths or *exostoses*, *cartilaginous* and *myeloid* tumours, all being, as a rule, of an innocent nature. There are the *osteo-sarcomatous* tumours, or fibrous tumours of bone, including those that have a periosteal as well as an osteal origin, the fibrous and osseous elements predominating in various degrees; and, lastly, there are the *malignant tumours of bone*, whether of the soft or the hard kind, osseous matter being mixed up largely with both; the disease acquiring the name of osteoid cancer when the bony elements predominate. These tumours grow from the periosteum as well as from the bone.

Exostoses.

Cranial exostoses.

Enostosis.

Exostoses may grow from almost every bone; from the cranium inside and out, as well as from the bones of the trunk and extremities. Those of the cranium are usually very dense and of ivory-like hardness; indeed, they are often called ivory exostoses, and sometimes are so hard that they cannot be removed. They may have broad bases, but at times are pedunculated, and in singular examples they occur as loose growths; these latter have generally occurred in the frontal sinus, and should be described as *enostoses*. Mr. Hilton has recorded an interesting case ('Guy's Rep.,' vol. i), in which such a bony tumour, of twenty-three years' standing (Fig. 582), fell out of a large cavity in the superior maxillary bone (Fig. 581). The man, in 1865, thirty years after the operation, was well, although disfigured by the hole in which the tumour had rested; and in a former page (page 14, vol. ii) I have recorded a case of the same affection and figured it (Figs. 306—7). These bony growths are more common about the orbit and air-cells of the head than elsewhere. True ivory exostoses of these parts do, however, occur, and at times attain a large size. Birkett has related ('Guy's Rep.,' 1868) such a case of Dr. V. Bruns', in which an ivory tumour of seventy-four years' existence, weighing ten pounds, grew from the occipital bone of a man, æt. 80. Exostoses from the jaws, or rather alveoli, are often called "epulis."

FIG. 581.

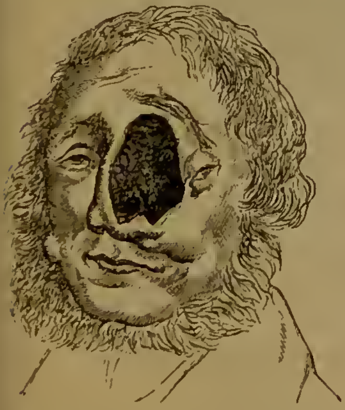
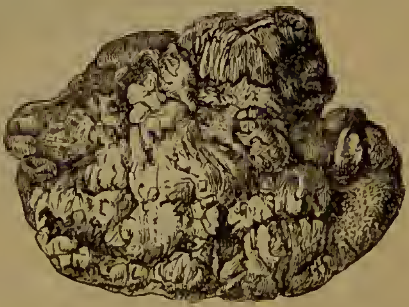


FIG. 582.

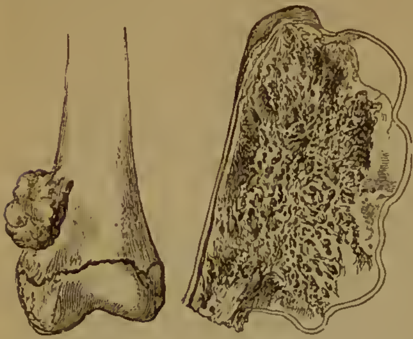


Tumour as discharged from cavity in Fig. 581, weight nearly 15 oz., circumference 11 by 9 inches. Mr. Hilton's case. Prep. Guy's Mus., 1666^{48}.

Exostoses on the extremities.

Exostoses on the extremities are not uncommon and are apt to spring from the point of junction of the shaft with the epiphysis,

Fig. 583.



Exostosis of the femur.

Their fracture.

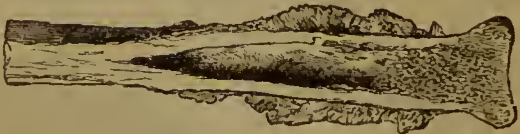
Multiple exostoses.

(Virchow considering this as the usual seat), and at the attachment of muscles. They are mostly outgrowths of bone capped with cartilage by which they grow (Fig. 583); exostoses, however, of long standing have an osseous shell. They have at times broad bases, but more frequently narrow peduncles. They are often curved or crested, assuming odd shapes, and may grow to a large size. In exceptional instances, they may die or necrose without any known cause, and as a result of accident they may be broken from their attachment. I have seen this in an outgrowth from the femur of a girl, æt. 12, who received a kick from a donkey; and a second case, in a patient of Mr. Birkett's, with an exostosis of the tibia. When broken off from their bony attachments they may in exceptional instances wither, but, as a rule, they will again adhere. In a patient of Mr. Maunder, in whom an exostosis of the femur was subcutaneously separated from the bone, adhesion took place, although at a better angle. At times, exostoses are multiple. In a girl, æt. 16, I found exostoses of different sizes on both tibiæ and both hands, one humerus, one radius, and ilium; and in two patients, 9 and 16 years of age respectively, five bones were so affected.

Periosteal exostoses.

Some exostoses have a *periosteal* origin, the result of organized inflammatory products; when they are usually diffused. Fig. 584 shows this well, and was taken from a patient of my father's, the late Mr. T. E. Bryant.

Fig. 584.



Periosteal exostosis. Prep. 1114^{60}, Guy's Hosp. Mus.

Ungual exostoses.

Ungual exostoses deserve a special notice, since they are even now too often mistaken for what is called an ingrowing toe-nail. They are generally found on the distal phalanx of the great toe (Fig. 56, page 232, vol. i), but Prep. 1287, Guy's Museum, shows a specimen from the little toe, and I have had under care two cases in which an exostosis grew from the ungual phalanx of the thumb, and one in which it was attached to the index-finger. Liston, in 1825, first drew attention to the nature of these cases.

The osteophytes and the outgrowths of osteo-arthritis are not classed amongst the exostoses.

Treatment.

TREATMENT.—When surgical interference is called for, nothing but the removal of these growths can be entertained, their bases being well levelled down to the bone or even scooped out. When, however they are placed near joints, this practice should be well considered. In a case in which an exostosis projected from the inner condyle of the knee I divided its base subcutaneously with a chisel, and pressed it back into the popliteal space, where it remained without giving trouble. In cranial exostosis, this operation may not only be difficult but impossible; still the attempt, wherever it can, should be made, for many successful attempts have ended in procuring the death of the exostosis and its subsequent exfoliation. In such a case, treated by Mr. Cock, where the removal of the whole from the orbit was impossible from its hardness, a part was removed, and what remained subsequently died and sloughed out.

Intracranial exostoses.

Intracranial exostoses are rarely made out during life, and are at times associated with epilepsy.

Statistics.

The following analysis of 120 cases of exostoses will show the seat of these growths. 45 were tabulated by my colleague, Mr. Birkett, in 'Guy's Reports;' and the remainder are from my private notes. Cases of epulis are excluded.

Frontal bone	3	Clavicle	3	Tibia	18
Upper jaw	1	Humerus	15	Fibula	4
Lower jaw	3	Ulna	1	Patella	1
Bodies of cervical vertebræ	1	Radius	2	Tarsal bone	1
Sacrum	1	Fingers	5	Metatarsal	1
Ribs	3	Ungual phalanx of thumb	2	Ungual phalanx of great toe	25
Ilium	1	Femur	18	Sole of foot	1
Scapula	10				

Three of the cases tabulated were examples of multiple exostosis; when the radius was affected, it was in common with other bones.

Enchondroma.

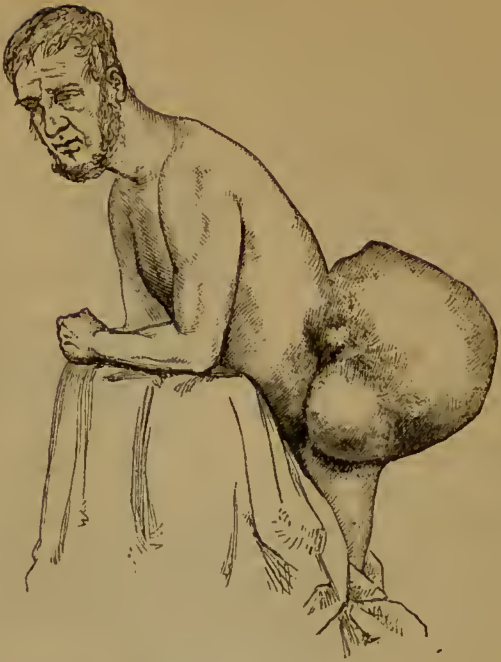
Enchondromatous or cartilaginous tumours of bone are most commonly met with in the phalanges and metacarpal bones. They are, however, seen surrounding bones having a periosteal origin, or growing from the bones of the upper jaw. A remarkable instance of this has been recorded in Chapter XIII, and figured in Fig. 218. It would appear that such cartilaginous tumours are more prone to attack the scapula than any other bones, and I have seen several such cases. Mr. Birkett has recorded and figured a fine specimen in the 'Guy's Reports,' 1866.

Pelvis sometimes attacked.

The bones of the pelvis are at times the seat of such growths. I have the records of a remarkable instance in which the pelvic surface of the ilium was the seat of the affection, and of another in which a middle-aged woman had an enormous cartilaginous outgrowth, the size of a cocoa-nut, springing from the pelvis, and occupying the inner side of the right thigh beneath the adductor muscles. The case from which Fig. 585 was taken occurred in the practice of my friend, Mr. Knaggs, of Huddersfield. It was of twenty years' growth. Cartilaginous tumours of bone usually originate in it, and are found in young subjects when the bone is growing. They are generally covered by a shell of the bone in which they originate, the shell is at times expanded it in all directions, but more usually in one. In Fig. 586, taken from a model in Guy's Museum, this mode of growth is seen. In Fig. 21 the section of such a growth is well illustrated.

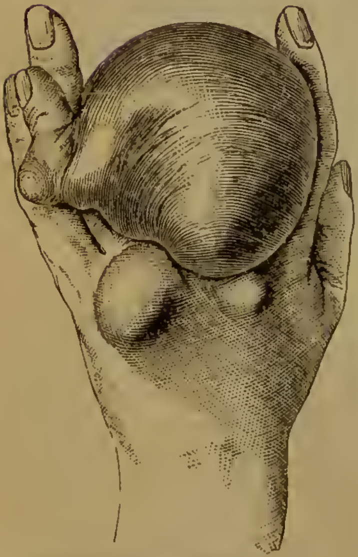
These cases are occasionally multiple, congenital, and hereditary.

FIG. 585.



Enchondroma of pelvis.

FIG. 586.



Enchondromatous tumours. From a model in the Guy's Museum.

Thus, in 1881, a man æt. 53 came under my care for a fracture of his thigh. He had at least a dozen outgrowths of bone or cartilage (ossifying enchondromata) upon his body connected with the shafts of his long bones. He was born with them. His father had three or four growths of the same kind as congenital tumours and his son was literally covered with them from birth, some being as large as oranges. My friend, Dr. Shuttleworth, of Lancaster, has published a like case in the 'Brit. Med. Journ,' Dec. 17, 1881.

Cartilaginous tumours are usually of slow growth and painless, with a smooth outline. At times they undergo decay and soften down, discharging a brown-coloured serous fluid unlike any other tumour; and under such circumstances are prone to disseminate like cancer. At other times they ossify and turn into bony tumours; the "bulbous exostosis" being often an ossified enchondroma.

Treatment.

Treatment.—Where a cartilaginous tumour can it should be scooped out of a bone, and in the phalanges and metacarpal bones this practice is usually successful. Extreme examples of the disease demand amputation or excision of the affected bone.

Recurrent enchondroma.

Enchondromatous tumours are at times recurrent, and in rare examples, return as malignant tumours in other parts of the body. Such growths having a periosteal origin are usually rapid in their increase and diffused. True cartilaginous tumours of bone are usually circumscribed and often multiple. The bones of the hand are at times much involved.

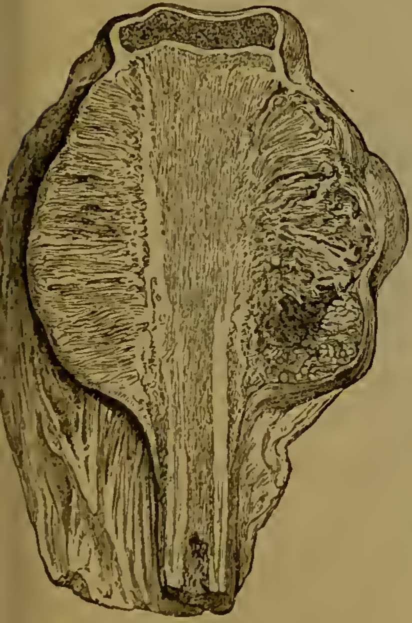
Osteo-sarcoma.

Osteo-sarcoma is a term of broad signification, and usually applied to the fibrous tumour of bone in which fibre-tissue and bone elements predominate in various degrees. Wilks believes "that they are altogether comparable to the fibrous tumours of soft parts." They usually have a periosteal origin—periosteal sarcoma—and even in exaggerated examples the shaft of the affected bone may clearly be traced through the growth. The tumour is usually circumscribed with a fibrous capsule, and divided by fibrous or ossific rays into different portions; at times the fibrous element predominates, at other the osseous. The disease is usually seen attacking the ends of the shafts of bone and not the epiphyses. All these points are well seen in Fig. 587.

Often semi-cartilaginous.

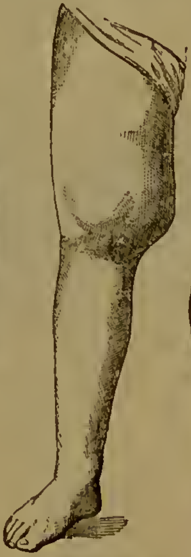
Cartilage is often found to be mixed up with the fibrous and osseous elements; and in proportion to the amount of bone matter entering into the formation of the tumour it may be regarded as innocent or otherwise; bony periosteal growths are rarely cancerous. When fibrous tissue, and more particularly the softer forms, predominate, the tumour is

Fig. 587.



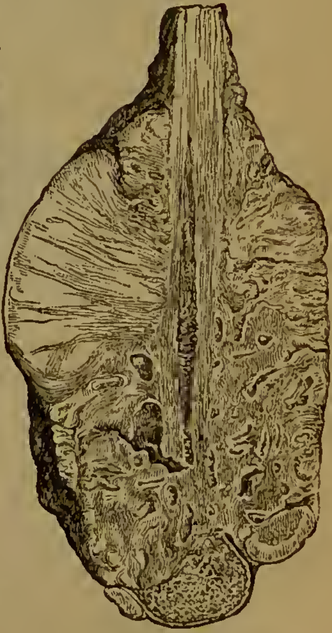
eriosteal osteo-sarcoma. Drawing 20, Guy's Hosp. Mus. Key's case.

Fig. 589.



Appearance of limb affected with osteo-chondroma.

Fig. 588.



Osteo-chondroma of femur Drawing 87^5.

prone to recur at the same spot, or in some other organ, as is the case with cancer.

Osteo-chondroma.

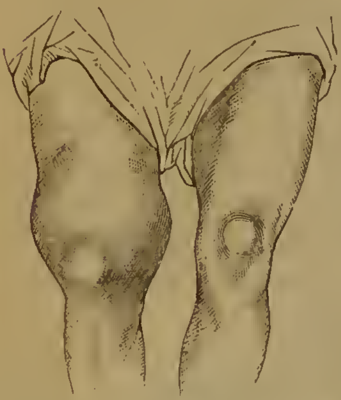
Osteo-chondroma is applied to a tumour involving bone, and made up of cartilage and bony elements in variable degress, the cartilage taking the place of the fibrous tissue of the osteo-sarcomatous tumour. In one case, bone will predominate, in another, cartilage. The disease is usually of slow growth and simple in its nature. In the case of a woman, æt. 34, from which Fig. 588 was taken, the disease had existed for three years. Fig. 589 represents the same tumour taken during life.

Myeloid tumours.

Myeloid tumours of bone are probably innocent, exceptional instances being on record in which a return in the part or in internal organs took place. They usually attack also either the epiphyses or epiphysial ends of the shafts of bones (Fig. 590). I have seen the disease, however, involving the shaft of the radius and upper jaw, and Paget has described it as attacking the breast. It begins commonly in the centre of the bone which it expands, forming a globular shell of bone, the spina ventosa of the older writers (Fig. 591). The interior of this shell is made up of fibre-tissue, or, it may be cystic, the cavity being divided by means of fibrous septa into more or less well-marked cystic divisions. The spaces themselves, or loculi, contain the characteristic myeloid material, "an opaque white, intermixed with a semi-transparent gelatinous-looking substance of a *cherry-red colour*," and their substance is made up of the characteristic polynucleated and irregular myeloid cells.

The cystic form.

FIG. 590.



Expansion of condyles of femur from myeloid tumour.

Joint usually intact.

When the tumour encroaches on the joint the cartilage is usually spread out over the tumour, but intact. These tumours were originally mixed up with the cancerous or fibro-plastic of Lebert. They are found likewise in the gums as "epulis," and in other parts. In a specimen of myeloid tumour of the upper jaw which I removed from a girl, æt. 8, the structure was very dense ('Guy's Rep.,' 1873-4-7).

Cancers of bone.

Periosteal and endosteal.

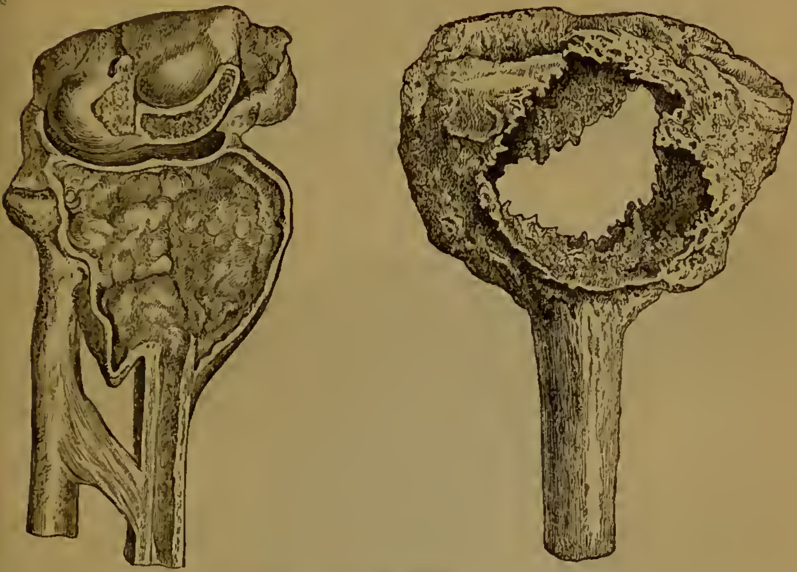
Cancers of bone, as of other parts, show their malignancy in effecting the utter destruction of the bones in which they are developed. They may originate in the periosteum or in the bone, but in either case both tissues will be eventually affected. When they originate from the periosteum, the bone may be found in parts running through the mass, and with cancerous elements surrounding the shaft (Fig. 593), but when the disease has existed for any period the same cancerous elements will be found in the shaft itself and destroying it. When the disease begins in the bone, it is usually in the medulla by one or more different centres, which by their increase, expand the bone and utterly destroy it (Fig. 592). The bones under these circumstances are very brittle and apt to break on the slightest force, even by ordinary muscular action, the fracture probably being the first indication of the presence of the can-

Endosteal form.

Spontaneous fracture in.

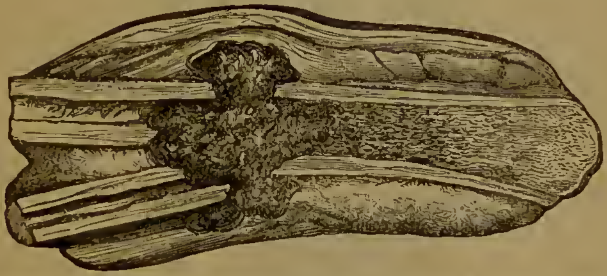
cerous disease. I have known fracture to occur under these circumstances by a patient turning in bed, crossing a street, or walking downstairs. In the majority of cases of cancer of bone, bone elements have little to do with the disease, though in what is called the true osteoid cancer, masses of bone of a condensed kind appear in the medulla, and gradually grow until a large osseous mass of disease is formed.

Fig. 591.



Myeloid tumours expanding bone. Guy's Hosp. Mus.

Fig. 592.



Fracture of the femur from muscular action at the seat of a local cancer in a man, æt. 28.

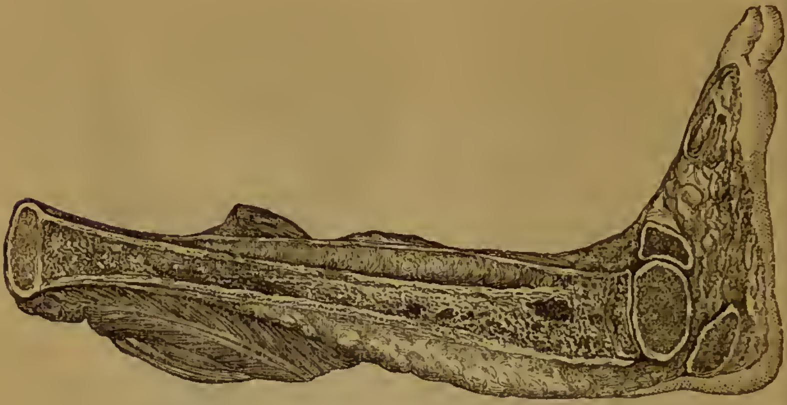
In Fig. 594 this form of disease is well seen, and was taken from a patient of Mr. Aston Key's, æt. 26, in whom masses of bone and cartilaginous tubercles were found in the lungs, pleura, and lymphatic glands after death.

Periosteal form.

The *periosteal* form of cancer (Fig. 593) grows more rapidly than the endosteal or interstitial, and very quickly assumes a large size; and is not often accompanied by pain; the swelling is rarely globular in its outline, but loses itself both above and below in the surrounding parts;

and in the integument covering it, large full veins, from obstruction to the deep veins will likewise be seen. It will possess a semi-elastic feel and often yield to the touch an unequal sensation as to density.

FIG. 593.

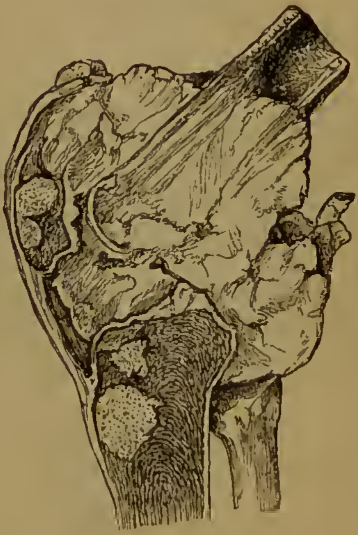


Periosteal cancer of the tibia.

Endosteal form.

Endosteal cancer is commonly attended with a dull aching pain, due to the expansion of the bone. Its increase is at first slow, but when it has so destroyed the bone as to have reached the periosteum, pain will be lessened, while the increase of the tumour will be more rapid. This form of cancer is more frequently secondary than primary.

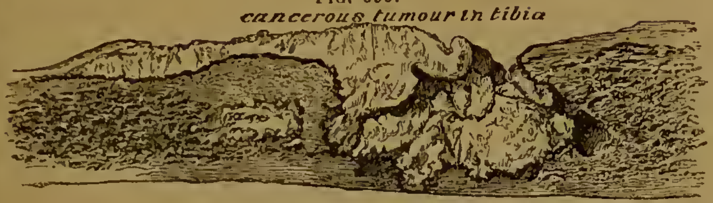
FIG. 594.



Osteoid cancer of knee-joint. Prep. Guy's Hosp. Mus., 1165^{50}.

Primary cancer of bone or periosteum is more common in children than in adults.

Fig. 595.



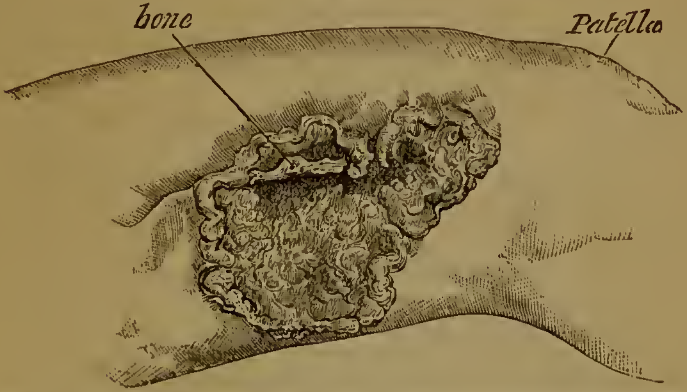
Cancer attacking necrosed tibia.

Epithelial cancer.

Subsequent to necrosis.

Epithelial cancer may attack a bone by the extension of the disease from the soft parts, as seen when cancer of the lips spreads to the jaws; and skin cancer may also extend downwards into a bone of an extremity and cause great destruction. At times, a bone that has been the subject of necrosis may become the seat of cancer, and, within a short time, I had three such cases under care, in two of which the tibia was the seat of the disease, necrosis having existed in both for upwards of twenty years; and in the third, although the femur apparently became necrosed twenty-two years before the man came under my observation, the cancer evidently began in the skin over it, and extended down the sinuses into the bone. Fig. 596 was taken from the limb of this patient during life, Fig. 595 was taken from the limb after amputation at the knee-joint in another case. In a man I treated years ago, the os calcis and the soft parts over it were the seat of the disease, and the bone after amputation was found infiltrated with cancerous epithelial elements; and more recently (1878) I amputated the foot of a woman which had been the seat of cancer for twenty-five years, and of necrosis for ten. For other cases *vide* 'Lancet,' Feb. 23rd, 1884.

Fig. 596.



Cancer of the skin spreading to the bone. From Edward Abrahams, æt. 42.

The Diagnosis of Tumours of Bone.

In most cases an approximation to truth can only be made.

Diagnosis.

A *globular* tumour situated in the articular end of a bone, and expanding it but not involving the joint, of slow, steady, and often painless growth in a young subject or adult, is probably myeloid.

A more *elongated or ovoid* tumour situated in the shaft of a bone of more rapid growth, with full veins in the soft parts covering it, and a semi-elastic, unequal feel, in a young subject, is probably a periosteal cancer.

A *firm, fibrous growth,* of a somewhat globular form, of gradual increase and unequal surface, fibrous in one spot, bony in another, in an adult, is probably an osteo-sarcoma, while a more indurated growth with a botryoidal outline, and a similar clinical history, is probably an osteo-chondroma.

Pain, rapid and diffused growth, with unequal density, glandular enlargement, venous obstruction, and wasting, generally indicate cancer.

Gradual, painless increase, a defined contour, globular, botryoidal, or in ridges, with no venous obstruction, glandular enlargement, or disturbance of the general health, usually indicate a benign tumour. The more globular the outline the greater the probability of the growth being myeloid. The older the patient and the more botryoidal the growth, the greater the chance of its being enchondromatous. The slower the growth, the more local and divided into septa, the greater the chance of its being osteo-sarcoma.

When a tumour is periosteal, by making firm pressure below the tumour, the bone will be made out to be on a lower level than the growth. When the tumour is endosteal and the bone expanded, on making firm pressure below the surface of the bone, the bone will be felt to rise gradually from the unaffected part over the surface of the growth so as to form a shell for it.

Treatment.

Treatment.—A tumour of bone can only be effectually treated by excision, and when it involves the articular end of the bone and encroaches upon a joint amputation is too often necessary. When the whole bone is involved as in a cancer, nothing but amputation can be entertained, and it is usually well to amputate high above the disease. If the tumour is placed in the head of the tibia, an amputation at the knee-joint may be performed, or, where this is inexpedient, just above the condyles. If the condyles of the femur are the seat of the disease the amputation should be at the centre of the shaft, it being justifiable to amputate at the hip-joint only when the disease is too extensive to allow of an amputation through the bone, for the hip-joint operation is most fatal and should be performed only when any less severe measure is impossible. In an evident cancer of the lower half of the femur, where amputation is to be performed, it had better be at the hip-joint, though in doubtful cases the limb may be removed just above the growth.

Amputation in cancer.

In the upper extremity, however, where amputation at any of the joints is, as a rule, successful, it is wise in cancerous disease to remove the whole of the affected bone and amputate at the articulation above. In periosteal cancers the whole bone should always be removed. Amputation for myeloid and simple tumours are generally successful; and a young woman for whom I amputated the thigh for myeloid disease, in 1861, was still well seventeen years after the operation.

Enucleation of tumours.

If a tumour involve the shaft of a bone, or the extremity of its diaphysis, but not the epiphysis, and the growth appears to be local and probably simple, an attempt should first be made to deal with it locally, to scoop or to turn it out, the more severe measure of excision or amputation being alone had recourse to should the minor fail. In the ease of the enchondromatous and fibrous tumours of bone, the minor measure is usually successful. In fact, in the treatment of tumours of bone, when the disease can be removed without making any great sacrifice of other parts, the attempt should be made. Amputation as a primary measure should be reserved for clearly cancerous cases or diffused growths, or for such as involve the articular ends of the bones, and, consequently, the joint. Some interesting cases illustrating the advantage of excising portions of the long bones when the seat of myeloid and other tumours, have been recorded by Messrs. Lucas and Morris, in the tenth vol. of the 'Clinical Society's Transactions.'

Pulsatile tumours.

Pulsatile tumours of bone are cancerous, as a rule, though they may be aneurismal. Cancerous tumours of the skull are frequently pulsatile, and in one well-marked case I had under care some time ago, in which the frontal bone was the seat of the disease, this pulsatile condition was its early symptom, the swelling being comparatively unnoticed. All pulsatile bone tumours have an interstitial origin and expand the bone, the new growth receiving its impulse from the large arteries that supply it. Gray ('Med.-Chir. Trans.,' vol. xxxix) has recorded an example of pulsating myeloid. True cases of *osteo-aneurism* are rare. Mr. Bickersteth, of Liverpool, has recorded such a case, and I had the pleasure of examining it carefully with Mr. W. Adams, and reporting upon it to the Pathological Society, vol. xix. It was, undoubtedly, a genuine case of this disease involving the tibia. Mr. Mapother ('Dublin Med. Trans.,' 1863) has recorded another. These cases are made up of expanded bone from aneurismal dilatation of the vessels of the bone.

Osteo-aneurism.

Their nature.

Treatment.

TREATMENT.—Pulsatile cancerous tumours of bone, like the non-pulsatile, ought to be treated by amputation; true osteo-aneurisms, of a limited size, when they can be made out, should be dealt with by local extirpation or by destroying them by means of the actual or galvanic cautery; and when very extensive, by amputation. Dr. Mapother cured his by the actual cautery, and Mr. Bickersteth by amputation.

Cysts in bone.

Cysts in bone are occasionally met with, and may be serous, sanguineous, or hydatid. The two former are most commonly met with in the jaws, and in Chapter XIII, attention has been directed to them. Whether they ever occur in the long bones is an open question, though in 1870 I trephined the enormously enlarged and expanded shaft of the tibia of a man, æt. 30, for gradually progressive disease of fifteen years' standing; the bone having been the seat of a fixed pain in its centre. I did so under the impression that the case was one of abscess, but having perforated a dense shell of bone, an inch thick, I came upon a cavity the size of an egg, which contained *no* pus though it was lined with the soft velvety material usually met with in abscess, and what escaped from it was not to be distinguished from the blood that flowed during the operation. The operation was quite successful, and a rapid cure ensued. I believe this case to have been one of cyst in the bone.

Hydatids

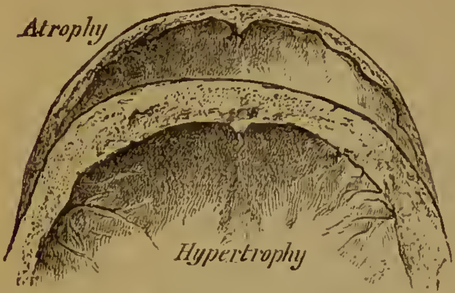
Hydatids are found in bone, and in Guy's Museum there is the head of a tibia containing a cyst or echinococcus which holds many smaller cysts within it; also another specimen illustrating the existence of hydatids in the vertebræ. In 1869 I treated with Dr. Freund, a case in which a large hydatid escaped from the expanded condyle of the humerus after a puncture in front of the joint. The hydatid had clearly made its way from the bone into the elbow-joint, and through this externally; a good recovery with a stiff joint ensued.

Hypertrophy and atrophy of bone.

Porous hyperostosis. Sclerotic hyperostosis.

Hypertrophy and atrophy of bone are pathological realities, although during life it may be a difficult if not an impossible task to recognise such conditions. Hypertrophies and chronic inflammatory changes are consequently often mistaken the one for the other, although in the former the enlargement is gradual and painless, and in the latter associated with local pain and other evidence of inflammation. In some cases the bone is enlarged and its cancellous structure expanded (porous hyperostosis); in another it is enlarged, but at the same time more dense (sclerotic hyperostosis). These changes are best seen in the calvaria (Fig. 597). In Prep. 1068^{35} in Guy's Museum, the bone is at least double its normal thickness. In rare cases the hypertrophy is clearly due to increase of function, as shown in another preparation in Guy's Museum, 1000^{15}, taken from a man who was a paralytic, and who had used his arms for progression; here the bones of the upper extremity are larger than those of the lower. In the majority of cases, however, the sclerosis of bone is due to inflammation, and in the case which Sir P. Hewett mentioned in his well-known 'College Lectures,' where the man's skull increased so imperceptibly year by year as to be only recognised by the gradual increase in the size of his hat, the disease was traced to an injury.

Fig. 597.



Hypertrophy and atrophy of the bone. From prep. in Guy's Museum.

This affection is pathologically interesting, though surgically nothing can be done for it.

Atrophy.

Atrophy is most commonly met with in the shafts of bones that have not been used for many years, as in paralytic subjects and persons who have been the subjects of joint disease; in the bones of the aged, and in those that have been injured. The bone may become a mere shell, its cancellous tissue being expanded, and its cells filled with a fatty matter.

Example.

When atrophy follows injury, Curling's suggestion ('Med.-Chir. Trans.,' vol. xx) that the causes may be found in injury to the medullary artery is probably right. This probably happened in the case of a man who came to me with an ununited fracture of the humerus, in whom I found the bone on exposing its ends for operation to be a mere shell and not half its normal thickness. It, however, cannot be the only explanation, as Norris has recorded ('American Journ. of Med. Sci.,' 1842) a remarkable case, in which after a double fracture of the humerus about its centre, the whole bone disappeared, the forearm subsequently swinging as a thong, while the arm became shortened six inches; the bone disappeared "by the gradual action of the absorbents."

In these cases, spontaneous fracture or fracture from slight muscular action is very prone to occur.

Elongation of bone from inflammation.

Arrest of growth from injury to epiphysis.

These cases of hypertrophy or atrophy must not be confused with the elongation of the shaft of a bone which is due to inflammation, or to the shortening of a bone from arrest of its growth following disease or the removal of the shaft, or to some injury to the epiphysial cartilage that connects the shaft with the epiphysis; for it cannot be too strongly impressed upon the student's mind that any disease or injury which interferes in any way with the nutrition of the epiphysial cartilage through which the long bones mainly grow, will be followed by arrest of the bone's growth, and consequently, by the shortening of the limb; that is, when the disease or accident occurs in early life during the period of growth. I have before me the notes of several cases where this result ensued. In one in adult life, the tibia was an inch shorter than its fellow after the removal of a necrosed shaft in childhood (*vide* Fig. 580); in another, nearly the same amount of shortening followed an injury to the superior epiphysial line of the tibia; and in a third, the same result followed a displacement of the lower epiphysis. In all these cases, the fibula was curved outwards, the shaft of the bone bent, and the outer malleolus much lower than the inner, the bone having grown as the others. In one case the head of the fibula was partially displaced outwards.

Mollities ossium.

Mollities ossium, or osteo-malacia, is a rare affection, and its cause wrapped in obscurity. It is found in men in about one case in ten of the affection, and in women is usually discovered during, even if it does not originate in, pregnancy. It chiefly attacks subjects who, from some cause or other, have been subjected to prolonged depressing influences, more particularly upon the nervous system.

Durham's views.

My colleague, Mr. Durham, in an able paper on the subject ('Guy's Rep.' 1864), writes "that mollities ossium is to be regarded as a particular expression, as it were, of a general morbid condition of the system, rather than as a special disease of the bones themselves," and I believe there can be little doubt as to the soundness of the opinion. It should never be confounded with rickets, or with the fragility of the bones met with in the aged or demented.

Symptoms.

"The first symptom of the disease," writes Durham, "is pain, more or less peculiar in character, always deep-seated, and greatly increased by pressure or motion, sometimes coming on suddenly and with extreme severity, sometimes commencing vaguely and insidiously, and gradually becoming almost insupportable; sometimes wandering, at other times fixed for a period to some particular spot, and subsequently spreading to other parts; sometimes intermitting, at other times unceasing. In the majority of cases the pain appears to have been first felt in the lower half of the spine, the pelvis, and loins; but in some it commenced in the feet, knees, or other parts of the lower extremities; the pains are often looked upon as rheumatic. Associated with the pain there has always been noticed, on the part of the patient, at a very early period of the malady, a feeling of general lassitude and disinclination to do anything. This feeling has increased more or less uniformly until it has ended in actual inability to make any exertion whatever, and with the early local changes are associated an uncertain, feeble gait, and continual fear of falling."

Symptoms that are more or less directly associated with the softening and absorption of the bones are the next to appear, such as diminution of stature, deformity of the spine or pelvis, some curvature or fracture of one or other of the long bones, and, as time progresses, these indications multiply, *flexibility*, conjoined with fragility, being the distinguishing character of the bones in this disease.

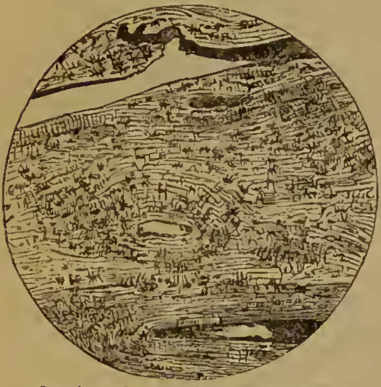
Urine.

The urine almost always contains a considerable excess of lime salts. The disease is rarely attended with any general or local symptoms of inflammation. The changes observed in the bones are carefully described by Durham. Increased vascularity appears to be an early symptom, the large grooves seen in the cranial bones being very striking; next, the bony matter is seen to be more opaque and less uniform than natural; sometimes it is irregularly granular, "as if some disunion must have taken place between the component elements of the bony matter."

Bone changes.

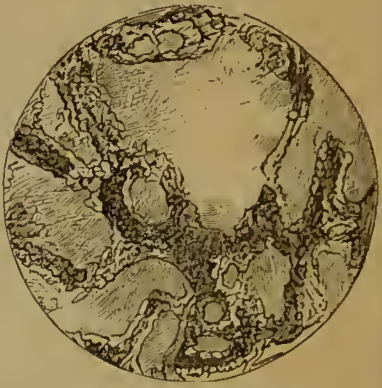
The lamination of the bones next becomes less distinct; the laminæ of the Haversian system appear more or less fused together; the bone-corpuscles become wider, although not with certainty more numerous At a later date the earthy matter becomes absorbed; the Haversian canals become surrounded by a transparent ring of animal matter; which rings then become disintegrated and absorbed. By this process the Haversian system becomes destroyed, the bone assuming a hollowed-out, porous, or somewhat sponge-like appearance. The contrast between the healthy and diseased bone is well seen in Figs. 598, 598A.

FIG. 598.



Section of normal occipital bone.

FIG. 598A.



Section affected with Mollities.

Durham, 'Guy's Rep.,' 1864.

The same changes occur in the cancellated as in the compact tissue. In the more advanced stage the bone disintegrates rapidly; *débris* of tissue, such as the remains of blood-vessels, shreds of membrane, fat- and oil-globules, with "marrow-cells," fill up the large spaces.

Chemical changes in the bone.

Chemically, the inorganic constituents are greatly diminished and chemical disunion and physical disunion co-exist, the earthy matter being more readily dissolved out of the diseased than out of normal bone. "In healthy bone," writes Durham, "the constituents are combined; in diseased bone they seem rather to be mixed. The animal constituents are likewise more fatty and less nitrogenized than in normal bone; the fat is more free. In the mineral constituents the proportion of the carbonate of lime to the phosphate is much diminished."

Prognosis and Treatment.

The *prognosis* in these cases is always bad, although the possibility of a cure should not be doubted. Trousseau relates cases in which a good result was obtained under the combined influence of rest, warmth, good food, and cod-liver oil; the deformity, of course, remaining. Lime salts ought not to be given in these cases, as they cannot be retained, and to give them, adds Durham, is only to throw additional work upon the excreting organs.

Rickets.

Rickets is an affection of early childhood, or rather of young life, since it has been known to affect animals, as proved by a skeleton of a West African baboon, shown at the Pathological Society of London in 1883, which exhibited the characteristic changes in the epiphyses of the long bones; and the head of a monkey, which was a fine example of craniotabes. In neither of these cases could syphilis be said to have had any influence. It is more of an acquired than an hereditary affection, but it may attack a fœtus *in utero*. It is said by Sir W. Jenner to be the commonest of the diathetic affections among the London poor. It is, however, found in the families of the higher classes, and it is essentially due to some mal-nutrition of the body connected probably with bad feeding, and the use of farinaceous in lieu of animal food, the bones, during their period of growth, expanding at their epiphysial ends and bending in their shafts, and being very prone to incomplete or green-stick fracture. "Displacement and obliquity of the epiphyses may ensue from softness and flexibility of the layer of bone uniting it to the diaphysis, as is seen more especially in the ribs; but a slighter degree of epiphysial obliquity is noticed in many of the joints of the long bones, such as the knee or ankle; the weight of the body is thus thrown unequally, so that one set of ligaments has to bear more traction than another. These ligaments then yield, and the joints become loose, so that rachitic knock-knee (*genu valgum*) or bow legs (genu *varum*) is formed.

Symptoms.

"From sustaining the weight of the body the femur bends forwards, the tibia usually forwards and either inwards or outwards, the greatest amount of yielding being where the bone is thinnest and weakest. In many cases we find the os femoris bent forwards, with anterior and outward curvature of the tibia, knock-knee and flat-foot being co-existent in the same individual. Just so far as the rachitic condition extends so may we look for abnormities of form; thus, the *pelvis* may acquire some of those well-known contractions of its outlet which are matters of such grievous moment to women at the period of parturition," the pelvis either retaining in adult life the small size and imperfect development of infancy, or becoming narrowed as to its cavity in one or other of its diameters.

The chest also undergoes allied changes, and Mr. Shaw has well pointed out ('Holmes's System,' vol. iii, p. 820) how "pigeon breast" is one of the effects of the disease; atmospheric pressure bending in the bones that have lost their elasticity and become softened, and causing a projection of the sternum and lateral flattening of the chest.

Lordosis.

In the spine a general curving of the whole column is the more usual deformity; "*lordosis*," or anterior projection of the lumbar vertebræ, as a compensating curve, being found when pelvic obliquity is present.

In all cases of rickets Humphry has shown ('Med.-Chir. Trans.,' 1862) that deficiency of growth co-exists with deformity, the lower limbs more than the upper indicating this in their proximal segment. In severe cases all the bones are more or less deformed, the *cranium*—often large — presenting a quadrilateral aspect, with sutures widely open till a late period of life, or even subsequently reopening, the bone either remaining thin or subsequently thickening. The periosteum in these cases is also usually thickened, both in the flat as well as in the long bones.

The general symptoms of rickets are those of debility, muscular and general weakness of the whole frame, gradually passing into that of rickets; dentition is retarded, and teeth decay or drop out. Sir W. Jenner lays great stress upon profuse perspiration of the head during the night, a tendency to kick off bedclothes, fetid stools, and general tenderness of surface, as constant symptoms of the early stage.

Pathology.

Tomes and De Morgan inform us that a rickety bone has the structural arrangement of normal bone without the earthy salts. Jenner ('Med. Times,' 1860), however, describes an enlargement of the lacunæ generally, the effusion of a red pulpy substance in the cancellous tissue, and a thickening of the periosteum; while Gee ('St. Bart. Rep.,' 1868), Dickinson ('Med.-Chir. Trans.,' 1852), and others, have pointed out how the viscera undergo some "albuminoid" changes, unlike the waxy or lardaceous disease.

In normal bone there is 37 per cent. of organic and 63 per cent. of inorganic matter. In rickets the proportion is 79 per cent. of organic and 21 per cent. of inorganic matter. Bones that have been solid may become pliable when this disease begins.

Rickets a curable affection.

Rickets is a curable affection, that is, if taken before it has far advanced, and it is remarkable to what an extent the deformities are remediable under natural processes, and how curved or bent shafts of bone recover their natural shape on taking off downward pressure and improving the general powers of the child. In more severe cases, where the curvature cannot be remedied, the bone consolidates and becomes strengthened by buttresses of bone along the concavity, and, although the stature may be diminished and the limbs deformed, the general powers of the patient may be restored and a sound recovery take place.

Treatment.

TREATMENT.—The *medical* treatment of rickets should be conducted on reasonable principles—fresh air and abundance of it, simple nutritious food such as may suit the conditions of the digestive organs being essentials; milk and beef tea for young children should be mostly relied upon, and meat in moderation for the older. Cod-liver oil, iron, and quinine, are also very valuable drugs. The bowels should be carefully attended to, while all violent purgatives ought to be avoided.

Treatment continued.

The *surgical* treatment in the early stages is the prevention of deformity, and in the later the remedying of it. By way of prevention, the child should be restrained from any prolonged standing or sitting position, the horizontal posture should be observed as far as possible, exercise should be allowed and followed by rest, the two alternating according to the powers of the patient and the necessities of the case. As the general health and powers improve, more liberty may be sanctioned. In spinal cases these observations are more especially binding, and in them movable couches and spinal chairs are of great service.

Where moderate deformity exists, more particularly in the lower extremities, it is often interesting to observe how, by the above means, the bones recover their normal shape, and children "grow out" of their deformity as their health improves, if only the Surgeon takes care it is not increased by neglect.

In still worse examples, and where exercise is essential and intermittent rest will not be observed, splints and instruments may be bound to the legs. Two long side-splints reaching to the ground, carefully bound together and removed at night, are as good as any, or an iron splint with joints at the knee and ankle. Some Surgeons prefer an outer splint for knock-knee, and an inner one for bow legs.

Operative treatment.

When the curvature of the shafts of the leg bones is very great or acute, Mr. H. Marsh has adopted the plan of forcibly straightening the bones when the patients are under chloroform. He thinks little of the risk of breaking the bone, knowing how rickety bones unite ('St. Barth. Rep.,' for 1870). He believes the plan more adapted for acute than chronic cases. In extreme cases, an osteotomy may be performed, or a wedge of bone may be removed from the shaft. I performed this latter operation in 1863 on the leg of a child between four and five years of age, and Mr. Little has more recently repeated the operation with advantage. It should only be done in extreme instances of deformity, and when no hope of improvement by other means can be entertained. Osteotomy for this affection is now a common operation.

Acute rickets.

"ACUTE RICKETS" has been described, but Dr. Barlow in a very able paper ('Med.-Chir. Trans.,' vol. lxvi, 1883) has clearly shown that such cases are a combination of scurvy and rickets, and that they should be called "Infantile Scurvy," the scurvy being an essential and the rickets a variable element. He carefully analyses thirty-one cases. The invasion of the disease may be gradual or abrupt, with more or less swelling of the legs, with pale, tense shining skin—but *without* increase of heat. There may be some redness of the part and some œdema extending up the thigh. The tenderness on pressure is extreme, so that the child cries even in anticipation of being touched. In severe cases the child moans constantly; there is also some pseudoparalysis of the affected limbs. When the disease affects the thigh all the local symptoms will be the same, only higher in the limb. Other bones may become affected simultaneously, or by subsequent involvement. In most of the cases there is head-sweating, and in some the bones of the cranium appear thickened near the sutures. In rare cases purpuric symptoms appear.

There is rarely very great increase in bodily temperature, and this seems to turn more upon the tension of the affected bone and soft parts over it than anything else.

In almost all these cases there is sponginess of the gums, and in many stomatitis.

The disease is a dangerous one, no less than seven out of Barlow's thirty-one having died.

The *pathological condition* of the affected bones is very marked. The periosteum is separated from the bones, and the shafts of the bones from the epiphyses; a layer of maroon-coloured blood-clots surrounds the bone. The bones affected may die in part, but not wholly as in inflammatory affections. It was this condition that induced Mr. T. Smith, who was the first to record a case of this disease ('Path. Trans.,' 1876), to describe it as one of hæmorrhagic periostitis. The periosteum may be thus separated from the cranial or any bone.

There is no reason to believe that syphilis has anything to do with this affection.

The disease tends spontaneously towards recovery under proper treatment.

Treatment.

The treatment recommended by Barlow is, *locally*, during the acute stage, wet compresses and avoidance of movement; at a later period, careful shampooing and douches. *Internally*, the use of raw meat-juice, fresh milk and orange-juice, or of some other fresh raw vegetable, and from the first the access of as much free air as is possible.

Osteitis Deformans.

This name has been given by Sir James Paget to a remarkable disease which he has described in papers published in vol. lx of the 'Trans. of the Royal Medical and Chirurgical Society,' 1877, and in vol. lxv, 1882. I have recorded in the 'Guy's Hospital Reports' for 1877 a good example of it, and have seen three since.

History and symptoms.

It begins, writes Paget, in middle age or later, is very slow in progress, may continue for many years without influence on the general health, and gives no other trouble than that which is due to the changes of shape, size, and direction of the diseased bones. Even when the skull is hugely thickened, and all its bones exceedingly altered in structure, the mind remains unaffected.

The disease affects most frequently the long bones of the lower extremities, the clavicles, and the skull, and is usually symmetrical. The bones enlarge and soften, and those bearing weight yield and become unnaturally curved and misshapen, suggesting the proposed name "osteitis deformans."

The spine, whether by yielding to the weight of the overgrown skull or by change in its own structures, may sink and seem to shorten, with greatly increased dorsal and lumbar curves; the pelvis may become wide, and the necks of the femora become nearly horizontal. But the limbs, however misshapen, remain strong and fit to support the trunk (*vide* fig. 599.)

In its earlier periods, and sometimes through all its course, the disease is attended with pains in the affected bones, pains widely various in severity and variously described as rheumatic, gouty, or neuralgic, not especially nocturnal or periodical. It is unattended with fever. No characteristic conditions of urine or fæces have been found in it, nor is it associated with any constitutional disease, unless it be cancer. Three out of the twelve cases recorded by Paget have ended in connection with this affection.

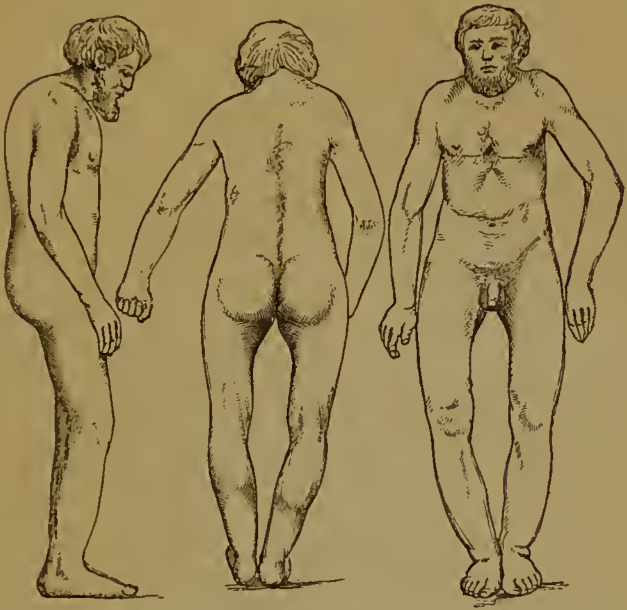
Connection with cancer.

Pathological changes.

The bones examined after death show the consequences of an inflammation affecting, in the skull, the whole thickness; in the long bones chiefly the compact structure of their walls, and not only the walls of their shafts, but in a very characteristic manner those of their articular surfaces.

"The changes of structure produced in the earliest periods of the disease have not yet been observed; but it may be believed that they are inflammatory, for the softening is associated with enlagement, with excessive production of imperfectly developed structures, and with increased blood-supply.

FIG. 599.



Drawing of a man suffering from osteitis deformans, taken from Author's case, 'Guy's Rep.,' 1877. This patient is now (May, 1884) dying. He is blind and bloodless, and can hardly raise his limbs on account of their weight.

"Whether inflammation, in any degree, continues to the last, or whether, after many years of progress, any reparative changes ensue, after the manner of a so-called consecutive hardening, is uncertain."

Effects on life.

The disease does not apparently have any shortening influence on first life, for in Sir J. Paget's case it had existed for twenty years, and in my own the man is now sixty-seven, the symptoms having shown themselves about eleven years. The patient is now amaurotic and so feeble that he cannot raise his heavy limbs. He is anæmic, but shows no other signs of disease.

Examples.

In May, 1877, I saw a second example of this affection in the person of a married lady, æt. 54, who, although in the enjoyment of excellent health, was quite unable to walk without crutches, on account of the weight and weakness of her legs. The disease had been gradually coming on for six years, and the pains in the thighs had given her great trouble. When I saw her she came into my room on crutches and sat down with the arched back so peculiar to this affection; her thigh bones were enormously thickened and bent, the necks of the femora were horizontal, as proved by the test line of the ilio-femoral triangle (Fig. 503), and the knees were far apart from the bowing of the legs. The bones of the upper extremity were also clearly enlarged. I could not make out that the cranial bones were involved. The lady informed me that she was at least an inch shorter this year than she was last; the changes in the necks of the femora would, however, account for this fact.

She had had two sisters; one died from cancer of the breast, while the second was an imbecile and had died in an asylum.

This case well supports the observations that have been made.

Sir J. Paget regards the disease as inflammatory; Dr. Goodhart brings forward another hypothesis. He does not think the term inflammatory can be considered as properly descriptive of this disease, partly because to give "inflammation" so wide a meaning as would embrace a general hypertrophy of all the bones, as one of its results would be to deprive the term of all significance; and also because it is still less applicable to other diseases allied to the one in question.

Dr. Goodhart considers that hyperostosis is essentially a new growth, or, as he expresses it, a generalized bone tumour, and adduces in support of this view:—1st. The clinical history of the disease; its co-existence with otherwise good health; the absence of pain, its intractability under treatment; its frequent association towards its close with some other form of malignant tumour. 2ndly. Its peculiar parallelism with molluscum fibrosum and a form of elephantiasis, which is a corresponding disease in the subcutaneous or fibro-cellular connective-tissue, to this in bone connective tissue. There is certainly a good deal to be said in favour of this view, and though Sir James Paget does not see his way to adopting it as the more probable, I am, on a review of the whole subject, and unfettered by any partiality for a theory of my own, inclined to think with my colleague.

No treatment seems to have the slightest influence on the progress of this affection.

CHAPTER XXXIV.

ON GUNSHOT INJURIES.

"Gunshot Injuries," writes Professor Longmore, "are the injuries which result from the action of missiles set in motion by a force which is derived from the ignition of explosive compounds. They comprehend every kind and degree of hurt which is capable of being produced on the human frame by the mechanical impulse of obtuse bodies." He informs us, moreover, that in every 100 casualties there are 20 killed to 80 wounded, and that of the wounded one third of the cases are severe and two thirds slight.

Statistics of wounded.

Their character.

The wounds vary much in their character and nature—one caused by a rifle ball differing from that by a cannon ball or shell; and the *direct* effect of a missile upon a part differs from that produced *indirectly* by the scattering of stones or any other hard substance caused by cannon shot or shell. *Gunshot contusions* of tissues, although apparently trivial, are, as in civil life, often associated with severe deep-seated injuries; and superficial wounds, apparently unimportant, are often attended with or followed by serious accidents. Gunshot wounds are always of the *contused* class; those of civil life, however severe, are rarely, if ever, attended with that complete attrition and displacement, and even total removal of substance, which are so constantly characteristic of wounds produced by gunshots, particularly in those of recent times. Gunshot wounds, moreover, are also prone to be complicated by the introduction into the wound of some foreign body, such as some portion of the soldier's dress pressed into the wound or some part of the wadding, shot, or shell itself.

It should also be known that "substances of very low degrees of density, such as plugs of tallow, light wood, cork, wads of paper and others, will serve to inflict penetrating wounds in the softer structures of the body, having all the characters of wounds inflicted by denser projectiles, if sufficient velocity be impressed upon them. But the necessary force to accomplish this result can only be executed within very limited distances."—*Longmore.*

"The external distinguishing signs of penetrating gunshot wounds are generally manifest enough. The general dimensions of the opening made by the shot sufficiently show whether it has been made by a small arm bullet, a large grape shot, or a still larger gunshot; its shape, whether it has been made by a round projectile, by a fragment of a shell, or an irregular splinter of some secondary missile, while the aspect and condition of the lips of the wound and of the structures immediately surrounding it, sufficiently mark it as not being one inflicted by a stabbing or cutting instrument."

Gunshot wounds differ considerably in appearance, these differences depending upon the forms of the missiles causing the injury, and their speed, as well as the part of the body struck, and the position of the patient relative to the projectile at the time of injury. When part of the body is carried away by a gunshot at *full speed* the surface of separation will present a level yet contused and almost pulpified aspect. When the *speed is less rapid,* the soft parts where the separation has taken place will be more lacerated and the bone comminuted; and when the *speed is spent,* or the direction oblique, the injured parts will either be crushed more or less deeply, or with little or no evidence of external injury, the deeper parts may be irreparably disorganised.

Again, bullets when at full speed perforate or penetrate, but when at lessened speed they crush and lacerate. When a gun is discharged *near the* body, the parts around the wound of entrance will be blackened and burned, while the wound of entrance appears as if punched out. When the discharge of the musket takes place *a few inches from the body,* the injured tissues will be more or less scorched, blackened, and studded with grains of unexploded powder, and the wound of entrance large, ragged, and excavated.

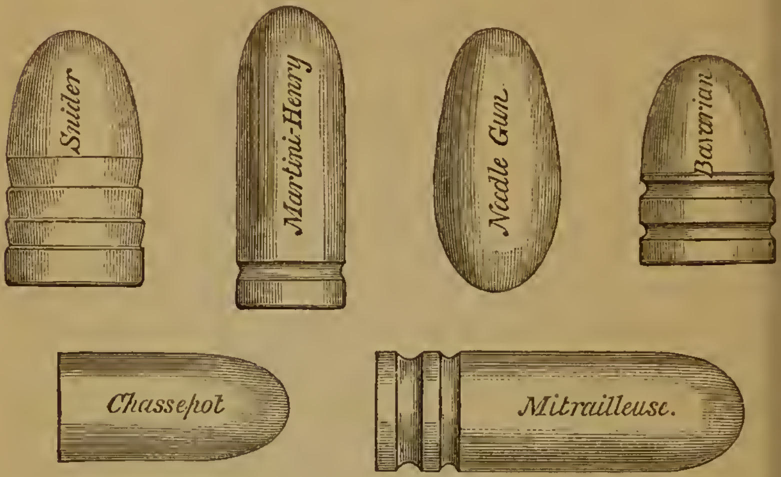
Wounds from bullets not at full speed, and fired at a distance of two or three hundred yards, will present an opening the size of the projectile, or possibly smaller, circular in shape, with serrated (inverted), undermined, puckered and flabby edges; at times, however, a flap of skin is found at the opening.

The margin of the opening will appear as if contused, the evidences of bruising fading away into the surrounding tissues.

When the *speed of the bullet is much* diminished, no skin may be carried away—the diminished speed of the missile simply stretching and tearing asunder the tissues to allow of entrance.

When wadding or other foreign substance has been carried into the wound of entrance, this will of necessity be more lacerated and appear larger than it would otherwise be; and the same conditions may be found to exist when a ball enters the body where bone is only covered with thin integument.

FIG. 600.



English and foreign bullets, now employed, of natural size.

In modern warfare, where the rifle bullets are of a cylindro-conoidal form (Fig. 600), soft parts are more readily penetrated and bones more generally split or splintered than was found, of old, from the impact of round balls. In the late Franco-German war these points were generally observed, and although the Prussian and Bavarian balls were said to be larger than those of the French, the wounds produced by all were very much alike; if anything, however, the wound from the needle-gun produced the wider tract and larger opening.

Penetrating wounds.

Indeed, in the "seton wounds," or wounds penetrating the soft parts alone, of all these balls it was often difficult to make out the wound of entrance from the wound of exit. When they traversed the soft parts alone, they often ran so cleanly through them that only slight suppuration followed and repair was rapid; these modern balls causing less severe lesions of the soft parts than the old spherical balls. Billroth asserts that wounds with split-like exits were remarkable for the amount of suppuration that followed. When bones were struck, no matter what the form of ball, the injury was alike; there was comminution, vertical splintering, and at times almost pulverisation. Indeed, in civil life there is nothing like the splintering and comminution of bones seen in wounds from rifle bullets.

Comminution of bone.

The amount of alteration in form which the projectiles assume after striking a bone is very remarkable—some being completely flattened, others strangely contorted, while many are split.

Dr. Knester, of the Augusta Hospital, Berlin, however, has proved by experiment (1874), that the amount of injury the bones and soft parts sustain in a gunshot wound depends much upon the softness or hardness of the bullet—a hard one going through a part and leaving a "seton wound," where a soft one would produce frightful destruction of tissue. He explains this fact by the lead of the softer bullets becoming heated by collision with bone and broken up (not melted). The Martini-Henry bullet is a hard one, and made of twelve parts hard lead and one tin. The bullet of the Gras rifle, the weapon of the French army, is likewise hard. The Chassepôt and the others are all made of soft lead, and consequently break up and flatten out against bone, thereby causing large apertures of exit and great laceration of tissue.

When the head of a bone is struck it is probably comminuted.

Bruising of bone.

When bones are not broken but only bruised, acute periostitis and endostitis are very common, the concussion of the bone being generally so severe as to excite acute action.

Course of rifle ball.

With the rifle ball the course is more frequently direct than with that from the old smooth-bored musket. Tortuous courses are even now met with, but less frequently, the weight of the ball and the extreme velocity with which it flies producing a more direct route. It penetrates the soft tissues in a direct line, and when it strikes bone either runs through or splinters it, entering it like a wedge. It will often appear, writes Longmore, that the track of a bullet, even at full speed, is widely removed from a straight line. But it usually is not difficult to reconcile the apparent irregularity in the course the projectile has taken if the many varied positions in which the body and its parts are liable to be placed are called to mind, and if, when making the examination, the Surgeon takes care to place the patient in a similar position to that he was in when struck.

Injury by spent balls.

The injury imparted to soft parts by what are called spent balls or *ricochet* shots is the most destructive, and large projectiles "*rolling over*" the surface of a part, or moving at low rates of speed, possess a force which will crush all parts, even whole extremities, with which they happen to come in contact, and rupturing internal organs in a way peculiar to themselves.

A conical rifle ball, when partially spent, may lodge in a part, either in a bone or some soft tissue. It may take some unusual path and lodge where the Surgeon cannot find it, or cannot remove it; and under these circumstances, it may rest, become encysted, and give but little trouble. But, on the other hand, it may set up a chronic inflammatory action in the part and give rise to local suppuration. Bullets, however, rarely lodge in the soft parts without giving rise to suppuration, although in bones they may do so. Such cases should not, however, induce the Surgeon to leave them alone when they can be removed; they should always be extracted if possible, unless they have penetrated any of the great cavities of the body. Billroth speaks very strongly on this point. In all blind tracks in the extremities the finger should be passed into the wound and the foreign body looked for, the external wound being enlarged when needed for this purpose; and in *non-penetrating* wounds of the head, chest, abdomen, and pelvis, the same practice may be observed. The removal of the ball as the cause of irritation has not only a beneficial influence on the body of the patient, but it has an equally beneficial influence upon the mind; for as long as the ball remains lost in the tissues the soldier naturally regards it as a serious impediment to his recovery, and there is no effect equal to that caused by its removal. Billroth

Ball to be extracted if possible.

has found much assistance from Nélaton's sound in doubtful cases, but, as a rule, he says that projectiles that cannot be reached by the fingers can rarely be extracted, the bullet forceps, even the American, being of small value.

Blow from cannon balls at full speed.

When a part of the body is carried away by a *cannon ball at full speed*, the stump will present a level surface of contused and almost pulpified tissues. The muscles and integument will not have retracted; the extremity of the broken bone will probably stand out, small fragments of bone being scattered over the surface of the wound.

Not at full speed.

When the same result follows the contact of a *cannon ball, the force of which is partially expended*, there will be evidence of more dragging and laceration of the soft parts, more irregularity of the wound, more hanging of the muscles, greater comminution of the bone, and greater injury to the soft parts above the seat of separation and probably greater splintering of the bone upwards.

When spent.

When the force of the *cannon ball is still less or spent*, there may be no separation of impaired parts, but a general contusion, crushing, or disorganization. In some cases, where the force is oblique, there may be no external evidence of injury, this want of external evidence being too commonly associated with broken bones or severe internal laceration of viscera or other soft parts. Such cases were formerly set down as due to "wind contusions," or the "brush of a shot," but are now believed to be caused by contusions of nearly spent cannon balls, or glancing blows from some projectile.

Shell wounds.

Shell wounds, as a rule, produce severe laceration of soft parts, and though they may penetrate tissues, yet they very rarely pass through them.

Rifle-ball wounds.

The wounds produced by rifle balls at full speed at the point of *entrance* are often small, circular, clean cut, and with inverted edges; but at the point of exit large, irregular, and with everted edges.

Wound of entrance.

As the distance from the weapon increases, and the velocity of the ball diminishes, so the wound of entrance becomes less circular and regular, larger, and more contused; the wound "sometimes consisting of three triangular flaps, which on being lifted up can be made to meet at their apices in the centre of the opening."—*Longmore.*

Wound of exit.

When the ball has passed through the part the wound of exit will probably be larger than the projectile, more irregular, torn, and everted than that of entrance, the subcutaneous fat often projecting. At times, however, with the cylindro-conoidal bullet discharged at full speed, it is difficult to distinguish by its appearance the wound of entrance from that of exit. In the patient's clothing, when the wound of entrance is punctured, that of exit will be lacerated.

Pain.

The *pain* caused by a gunshot wound depends upon the parts that are injured. In a general way it is not severe, and, when so, is evanescent. Writers tell us that it is often described like the sudden stroke of a cane, or the shock of a heavy blow. Sometimes soldiers are unaware of their wounds. When the trunks of nerves are pushed aside and injured, intense pain may be felt, but not locally. Longmore relates the case of an officer, who, from his sensations, thought his arm was broken, but on examination no such injury existed; a ball had passed from right to left through his neck, which probably injured some of the cervical or brachial plexus of nerves, thereby giving rise to his error. More pain is occasionally felt at the wound of exit of a bullet than that of entrance.

Shock.—"When a large bone is suddenly shattered, a cavity penetrated, an important viscus wounded, or a limb carried away by a round shot, the most prominent symptom is the general perturbation and alarm which in most cases instantaneously supervene on the injury. This is generally described as the 'shock' of the gunshot wound. The patient trembles and totters, is pale, complains of being faint, perhaps vomits. His features express extreme anxiety and distress. This emotion is in great measure instinctive, and seems to be sympathy of the whole frame with the part subjected to serious injury, expressed through the nervous system. This shock is more or less persistent, according to circumstances. Examples seem to show that it may occasionally be overpowered altogether, even in most severe injuries, by moral and nervous action of another kind, by a state of mental tension; but this can rarely happen when the injury is a vital one. Panic may lead to similar symptoms of shock, although the wound is of a less serious nature. A soldier, having his thoughts carried away from himself, his whole frame stimulated to the utmost height of excitement by the continued scenes and circumstances of the fight, when he feels himself wounded, is suddenly recalled to a sense of personal danger; and if he be seized with doubt whether his wound is mortal, depression as low as his excitement was high may immediately follow. This depression will vary in degree, according to individual character and intelligence, state of health, and other personal peculiarities. For while, on the one hand, in every action numerous examples occur of men walking to the field hospital for assistance almost unsupported after the loss of an arm or other such severe injury; on the other, men whose wounds are slight in proportion, are quite overcome, and require to be carried.

Effects of shock.

"As a general rule, however, the graver the injury the greater and more persistent is the amount of 'shock.' A rifle bullet which splits up a long bone into many longitudinal fragments inflicts a very much more serious injury than the ordinary fracture effected by the ball from a smooth-bore musket, and the constitutional shock bears like proportion. When a portion of one or both of the lower extremities is carried away by a cannon ball, the higher towards the trunk the injury is inflicted the greater the shock, independent of the loss of blood. When a ball has entered the body, though its course be not otherwise indicated, the continuance of shock is a sufficient evidence that some organ essential to life has been implicated in the injury."—*Longmore.*

Hæmorrhage.

Hæmorrhage.—The amount of hæmorrhage attending a gunshot wound varies according to the size and situation of the wounded vessels. When large vessels are involved death is rapid, and such cases do not come under the notice of the army Surgeon.

Primary.

In the cases that come into the Surgeon's hands in a general way there has been an attack of hæmorrhage directly after the injury, but little more; possibly some oozing, but rarely much, may exist.

When a limb is shot off there is rarely more bleeding than when it has been torn off by machinery, as seen in civil life. Large vessels, when torn or twisted, seldom bleed. In these cases the plugged pulsating extremity of the lacerated artery will generally be found projecting from the wound.

In the wounds caused by *rifle balls* vessels escape in a marvellous manner, the great resiliency of large vessels and the freedom with which they slip away under pressure from their loose cellular connections, allowing a ball to pass along or across their course without wounding them. At times the vessel may be so contused as to become obstructed and obliterated (*vide* Prep. at Netley). Nevertheless, a rifle ball occasionally may directly divide a large artery, and cause instantaneous death. In the American war, among the cases of primary gunshot lesions of the arteries that came under treatment, it was found that in most only a portion of the calibre of the vessel had been carried away, and that retraction had thus been prevented.

Obliteration of artery from contusion.

Secondary.

Secondary hæmorrhage is common in gunshot wounds, and is due, probably, as a rule, to the reopening of a wound in a vessel temporarily closed, or to the sloughing of some part of its walls that had been injured. In the *former* case, the new tissue that had stopped for a time the flow of blood gives way under some sudden movement or local mechanical force, such as some foreign body in the wound; or breaks down during the suppurative or sloughing process. In the *latter* the injured coats of the artery are cast off, having been destroyed by some contusion or other violence. In either case the thrombus or clot in the vessel is not sufficiently well formed or organized to resist the force of the blood current from behind. When such a clot organizes, there will, of course, be no bleeding. "The great frequency of secondary hæmorrhage has for its chief causes the absence or faultiness of sanitary conditions, and the debility of the patient, due to privation of nourishing food, and to exposure. The means calculated to remove or anticipate such evils will, if applied, be of more value than is the ligature in coping with secondary bleeding after gunshot injury."—*MacCormac.*

Treatment of secondary hæmorrhage.

With respect to the treatment of secondary hæmorrhage after gunshot wounds it is in principle similar to that which the civil Surgeon follows. Styptics where large vessels are concerned are worse than useless. Pressure is only applicable for temporary, but not curative purposes, and thus the Surgeon is driven to cut down upon the wounded artery to tie or twist both ends, or, to apply the same practice to the vessel in its continuity leading to the seat of bleeding when the former operation is too difficult or dangerous. Billroth advocates dealing with the main trunk of the bleeding vessel at an early period of the hæmorrhage, and not wasting time by delay. He says that out of twenty-three cases in which he applied a ligature to large arteries for hæmorrhage, death took place in seven from bleeding on the separation of the ligature, when no clot was found in the vessel; in twelve from hæmorrhage and pyæmia, of which no examination was made, and seven alone recovered.

In the late Continental war Stromeyer and MacCormac maintain that the result of such operations was uniformly unfavorable. Out of twelve cases which Stromeyer saw only two recovered. "I think," he says, "we must decide to amputate oftener in cases of secondary hæmorrhage."

Possibly a better result might have followed torsion of the arteries, for, after such a practice, when bleeding has been arrested, there is nothing to set up fresh mischief in the artery, no foreign body like the ordinary ligature to excite any ulcerative or disorganising process through which hæmorrhage may take place; the thrombus that forms in the vessels after torsion being allowed to go on undisturbed, to organize and become incorporated with the incurved middle arterial coat into one firm organised fibrinous mass. The catgut ligature, however, may possibly be of use in these cases.

Treatment.

Provisional.

Treatment.—In the front of the battle-field little more can be done in the way of treatment of gunshot wounds than the application of the "first field dressing;" some pressure or tourniquet to arrest hæmorrhage when the vessel cannot be at once secured; some splint or other available support to prevent extra injury being inflicted by movement to the field hospital. The wounds of the soldier must not be manipulated by the Surgeons in the front. No examination of the wound is to be made by probe or finger in the battle-field or dressing station. "The one line of treatment to be adopted by the Surgeons in the front," writes Professor C. Reyher, "is to occlude the wound provisionly, to lay the wounded part in a suitable position in the litter, and to render it provisionally immovable," for the Surgeon is to remember that a proper and thorough examination of the wound will take place at the field hospital.

Field dressing.

The first field dressing was introduced during the Crimean war in 1853 by Professor Longmore for the first time in any service; "and since that period," writes Longmore, "it has been copied by every civilized Power in the world—the principle of every man carrying on his person the means of dressing his wound if he should eventually meet with that calamity."

What the first field dressing should be is not yet determined, but to carry out the practice efficiently it is necessary that the bearer companies should be well organised, and the men of which they should be composed must be expert dressers. The appliances at hand for their use must also be effective, simple, portable, and last, but not least, cheap. That they should be of an antiseptic nature all Surgeons will now admit. That they should be absorbent is equally essential. Iodoform, absorbent antiseptic cotton, or gauze and a bandage are probably the three best essentials, and if a piece of protective or waterproof material is added to the list so much the better. Before examining a wound the clothes that cover it should be carefully looked to, and more particularly the garment next the skin, for "it occasionally happens that a bullet will have sufficient force to penetrate the body to a limited distance, at the same time carrying a portion of the wounded man's shirt before it, while owing to the yielding nature of the material it fails to tear a piece out of it. The bullet will then lie, as it were, at the bottom of a pouch of the shirt like the finger in a glove; and when the shirt is taken out the bullet will be brought away with it." Longmore, in his recent work on "gunshot injuries," relates several instances of the kind.

Final.

At the *field hospital* the wound should be thoroughly and carefully examined, and to do so, the patient should be placed, when practicable, as near as possible in the position he occupied when he received it. All foreign bodies must be taken away, bleeding vessels ought to be ligatured or twisted; and, when necessary, the wound should be enlarged for the purpose. No makeshift of pressure or other temporising means should be employed. When great collapse or "shock" exists some gentle stimulant may be given. The true condition of parts is to be made out at once, and the plan of treatment laid down, soft parts being adjusted, operative interference decided upon when necessary, and right appliances employed. To clean the wound some antiseptic lotion should be used. Iodine lotion, made up to strength of a dark sherry colour, is the most available and as good as any; and in this I have the support of Professor Lister; but carbolic or salicylic acid may be employed. The spray in military if not in civil surgery may fairly be said to have been set aside by common consent. Brun, Volkmann, and Billroth, amongst German Surgeons, have all abandoned it, and Sir J. Lister has said, "I do not desire that the spray should be used in military practice; I *believe essentially the same results can be got without it.*" So now all Surgeons are on the same platform as to principles, and only differ in points of detail.

Exploration of wound.

By far the best instrument to explore a wound is the finger, and for this purpose the external opening through the fascia may always be enlarged. "Probes should seldom or never be used; the finger is by far the best instrument if the wound will admit it" (John Hunter, MS. lect., 1787). "No artificial instrument can give the same amount of information or afford information so precise with regard to the lodgement of foreign bodies and their nature as the Surgeon's finger can give. The Surgeon should not withdraw the finger until the course the projectile has taken, the injury it has done, the complications of the wound, such as the presence of foreign bodies, and in such a case, their kind and situation, have been decided by him; the exploration will then be completed by one operation, and a second insertion of the finger for the purpose, which is always irritating to a patient, will be avoided. The knowledge gained, moreover, will be definite and of special utility in determining the proceedings to be afterwards adopted. The exploration is often assisted by pressing the soft parts, especially if the wound be in one of the extremities, from an opposite direction towards the finger end." Sometimes, when a lodged ball cannot otherwise be discovered, it may be found by passing the flat palm of the hand down the limb. "Sometimes," writes Longmore, "it may be detected simply by relaxing the muscular tissues, so as to give a loose and pendulous condition to the parts concerned, and then lightly tossing up the flesh at different points from below with the tips of the fingers." When the finger passes through an opening in fascia or a deep aponeurosis, the track will feel constricted, when through muscles and connective expanded.

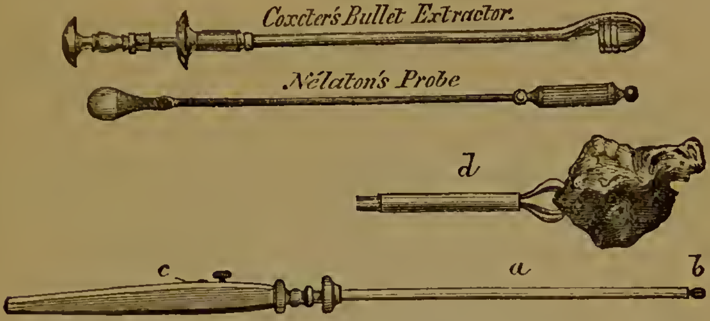
By finger.

By probes.

When sufficient information cannot be acquired through the finger either from the length of the wound or its tortuosities, probes must be used. Nélaton's (Fig. 601), with a small ball of porcelain at the end, is good, and so also is Sayre's snake-jointed probe, with a like end. Longmore prefers a long silver probe, which can be bent to any angle, but speaks highly of Dr. Lecomte's stylet-pince. It responds as an indicator with even more distinctness than the Nélaton probe in all cases in which the test would be of service, while it answers for a variety of other cases in which Nélaton's probe would give no indication at all. By it small particles of the substance embedded in the tissues can be extracted for examination, and many foreign substances altogether removed.

In gunshot fractures of the shafts of bones which are to be treated conservatively, Stromeyer advises that no probing ought to be performed, and in doubtful or in operation cases, it ought only to be done just before the operation or under chloroform.

Fig. 601.



Lecomte's Stylet-pince.

a. Canula moving over; (*b*) cleft steel rod with closed curettes at end, fixed in handle; (*c*) the gliding of the canula determining the opening or closing of the curettes; (*d*) curettes open grasping bullet.

Electric indicators.

Electric indicators have been employed, and some are most ingenious and possibly valuable, but they are not portable. The appliance of Mr. De Wilde, in which contact with the metal of a ball is notified by the sound of a bell, is particularly taking, and a very useful apparatus has also been made by Messrs. Krobne and Sesemann, of Duke Street, Manchester Square. Professor Longmore speaks highly of both, but prefers the latter. It is designed to ascertain, with absolute certainty, if a substance lodged in the body, and admitting of being touched with the probe or grasped with the forceps, is a bullet, a fragment of a projectile, or other metallic substance. The probe is elastic, and follows the track of any projectile more readily than a stiff probe. Two sharp needles are concealed in it, which, when a hard body is felt, are pushed forwards one after the other. This is done by pressing the small buttons on the handles towards the probe. As soon as the two points touch the foreign substance, if it be metal, the electric current passes through the instrument, a fact immediately indicated by the hand on the dial. The hand moves actively either towards the right or left side. The forceps possess this principal advantage that they can be also used as a probe, thereby dispensing in many cases with the use of the elastic probe altogether. The extremities are furnished with Assalini's points, with which particles of clothing can be removed, if such should be before the projectile. If a foreign body is touched with the forceps it should be gently grasped between both blades. If it be a bullet or any piece of metallic projectile, the electric current passes through it, and the hand on the dial moves again actively, as described above. It is, of course, necessary to fix the connecting wires of the instrument into the brass heads on each side of the dial. In the drawer below the dial there is a small battery charged with sulphate of mercury. If the charge has become too dry and weak it should be moistened with a few drops of water, and a few pinches of sulphate of mercury should be added. It is to be observed that the zinc plate touches the platinum points in the trough.

In exceptional and chronic cases where time has been allowed to pass, these instruments are of greater use than in primary cases.

It need hardly be reasserted that when a ball has penetrated any of the cavities of the body such as the head, chest, or abdomen, it is not to be sought for on any account.

Removal of bullet.

When a foreign body has been detected it should be removed; at least this is the rule. Coxeter's extractor, composed of a scoop for holding and a pin for fixing the bullet, has been highly praised (Fig. 601). Instruments with blades cannot be recommended as they necessitate the dilatation of the wound.

Forceps.

MacCormac writes, "The bullet forceps I preferred was one with claw points, at a right angle with the handle, and slightly overlapping, so as to admit of easy ingress. When these catch the bullet they rarely let it slip. The extraction of bullets, however, requires skill and patience; much injury may be inflicted on surrounding parts by the incautious use of the bullet forceps."

Enlargement of wound.

When, from the smallness of the wound of entrance, force is required, it is better to enlarge than to stretch the wound. When the foreign body rests beneath the skin, an opening through it may be made.

When in bone.

When balls lodge in bone they should be removed as from soft parts; when they can be raised from their bed by an elevator, such an instrument should be employed. When forceps are wanted for extraction, Luer's "sharp-pointed bullet forceps, which bite into and secure a most firm grasp of the object, will best accomplish the extraction." To aid extraction the gouging away of some part of the bone may be necessary.

Wounds into joints.

As a rule, however, with rifle balls, the bone is splintered; and, under these circumstances, when the epiphysis of the bone is involved, excision of the joint is called for when the joints of the upper extremity or the head of the femur is involved, and amputation when the knee and ankle are injured.

After the removal of all foreign bodies from the wound, and when the parts have been cleansed, they should be carefully adjusted, placed at rest in an easy position, and protected by wet or dry lint; union by adhesion is out of all question, and that by granulation alone can take place.

To hermetically seal a wound is not a practice to be generally recommended. Some gentle support by means of a bandage not only gives comfort, but is beneficial.

When suppuration has taken place the greatest care is needed to prevent burrowing. As soon as abscesses form they should be lanced, and that freely. When the wounds of entrance and exit are opened, the intervening sinus may be syringed with advantage, some medicated lotion such as iodine water, Condy's solution, or carbolic acid, one part to a hundred, being used.

Under all circumstances, thorough cleanliness should be observed, good food with tonics and sedatives given; fresh air being allowed to circulate freely around the beds. Stimulants should be administered with great caution, enough only being allowed to assist the digestion of solid food.

Gunshot wounds of soft parts usually suppurate about the third or fourth day, sloughs mostly separate about the tenth or fourteenth;

and recovery takes place in five or six weeks, the wound of exit, as a rule, closing before that of entrance.

Gunshot Wounds of the Head.

Gunshot wounds of the head.

A gunshot wound of the head received from a rifle ball at full speed produces a *diffused* injury to the skull and its contents; when caused by a spent ball or by a fragment of shell, the injury may be *localised*.

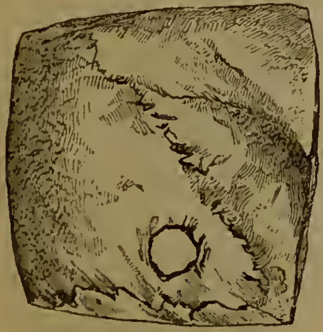
In the former cases the external evidence of injury bears no comparison with the real mischief the patient has sustained. In the latter the external evidence may be greater than the internal. Thus, the experience, says Professor Longmore, of the military Surgeon, leads him always to hesitate in forming a prognosis, however limited a gunshot injury may appear to be at first observation.

Gunshot injuries, are, moreover, specially prone to be followed by diffused meningitis, encephalitis, and the formation of deep-seated abscesses, this proneness to traumatic inflammation being clearly due to the injury the brain itself with its membranes has sustained; for in head injuries with which the civilian is familiar, this tendency to traumatic encephalitis bears a direct proportion to the injury of the cranial contents.

The opening made into the skull by a pistol ball when at full speed is clean and defined; that of exit larger and bevelled outwards. They are rarely complicated with fissures. When, however, the velocity of the ball is in a manner modified, there may be the same amount of "starring" at the wound as is seen by the civil Surgeon.

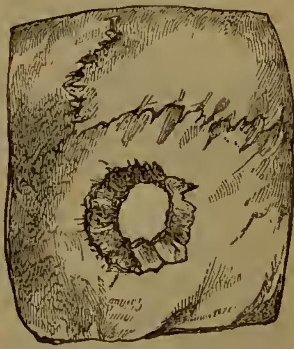
In military as in civil practice the inner table of the skull is always fractured to a greater extent than the outer when the ball enters from without (*vide* Figs. 602-3, taken from Longmore's article in 'Holmes's System'; but the opposite condition exists when the ball passes through the skull on the opposite side of the cranium, the table of the skull corresponding to the point of exit of the ball suffering the most in both cases.

Fig. 602.



Wound of Entrance.

Fig. 603.



Wound of Exit.

External injury no indication of internal.

In military as in civil practice the amount of external injury is no indication of the amount of internal mischief. A spent ball, a fragment of shell, a stone, may cause what appears to be only a contusion of the scalp, yet a fracture may co-exist with such a contusion, and a considerable amount of intracranial mischief follow. "The amount of bruising obvious to sight and the degree of concussion may have seemed trifling, and yet the remote consequences may be serious enough."—*Longmore.*

Contusing shots of head.

Contused gunshot injuries without any external evidence of cranial mischief are at times associated with such intracranial injury as to be followed by a speedy death. "Contusing and glancing shots," says Dr. Neudörfer of Prague, in his 'Manual of Military Surgery,' "will either occasion fissures, fractures, or depressions, or not interfere with the integrity of the skull at all, according to the velocity of the projectile and the elasticity and power of resistance of the bones."

Severe scalp wounds are generally caused by the impact of a projectile at an acute angle. Under such circumstances the bone is often left intact, and little or no injury to the brain results.

Injury to bone.

At a less acute angle, the bone may be bruised, scratched, or furrowed, fissured, starred, or comminuted, and with these several conditions, more or less severe brain symptoms may be associated, the gravity of the symptoms depending on the severity of the concussion.

Concussion in military as in civil experience means either a temporary suspension of brain functions, a contusion or laceration of the brain structure, or a more or less severe extravasation of blood upon or into the brain itself; a severe contusion of the skull without fracture being quite capable of producing a fatal laceration of a sinus.

Fracture of inner table without that of outer.

"A simple observation of the injury to the outer table, whether by sight or touch, will by no means necessarily lead to a knowledge of the amount of injury or change of position in the inner table."—*Longmore.* Indeed, it is quite possible for a piece of the inner table of the skull to be fractured and detached without any fracture of the external taking place. This is illustrated in Figs. 604-5, taken from the drawing

Fig. 604.

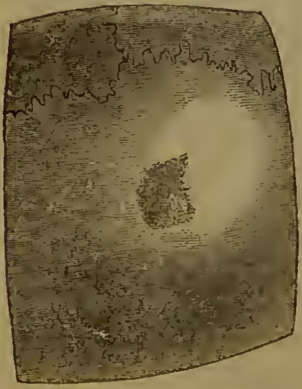
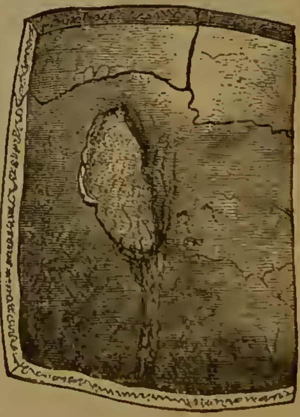


Fig. 605.



Circular No. 6, Figs. 4 and 5, Washington.

Fig. 604.—Exterior view of the afore-mentioned specimen.
Fig. 605.—Fracture of the vitreous table of the frontal bone, without fracture of the external.

of what is believed to be a unique specimen (2313, A. M. M.), in the United States Museum, published in Circular No. 6.

When the external table has been ploughed off by the projectile, care should be taken not to mistake such an injury for a fracture of both tables with depression.

In military, as in civil practice too, *fissured fractures* are mostly the result of blows by heavy projectiles, and fissures of the inner table without external evidence of the injury, occasionally occur.

Comminuted fractures.

Comminuted fractures in both military and civil experience are also chiefly local injuries, the force of the ball or blow expending itself on the injured spot.

Wounds with fracture and depression.

Wounds complicated with fracture and depressed bone without lodgment of the projectile are most serious. Of seventy-six cases recorded after the Crimean campaign, fifty-five proved fatal, and of the twenty-one survivors twelve had to be invalided; "the severe concussion of the whole osseous sphere by the stroke of the projectile, the bruising and injury to the bony texture immediately surrounding the spot against which it has directly impinged, as well as the contusion of the external soft parts, so that the wound cannot close by the adhesive process, constitute very important differences between gunshot injuries on the one side and others."—*Longmore.*

Bullet often retained.

Fractures of the cranium from gunshot wounds are not unfrequently *complicated with the retention of the projectile.* It may be that the ball has been flattened against the bone and lodged in the wound, or it may be that it has been split against the fractured cranium, one portion entering the skull and the other the integument. Under either circumstance, the segment that enters the skull may lodge either between the bone and the dura mater, or lacerate the membranes and enter the brain. Longmore gives a case in which there was a fissured fracture with slight depression, but no hole in the skull, where, after death, half the rifle bullet was found in the brain, the hole through which the half bullet had forced admittance having closed as soon as it had entered the skull. He gives, also, another precisely similar, which reflects great credit upon the Surgeon, Dr. B. Howard, of the United States, in which, from the presence of a single hair protruding from within the broken bone, it was inferred that a solid substance had entered the skull. Trephining was performed, a distorted Minié ball removed, and recovery ensued.

Perforating wounds fatal.

Rifle bullets at the usual speed, however, in the majority of cases enter the cerebral mass, to make their exit, in some instances, at the opposite side of the skull, in others to rest beneath the opposite wall; at times, the ball takes a circuitous route. In all death follows, as a rule, no exception to this fact having been reported from the Crimean war.

Treatment.

Immediate.

TREATMENT.—To do nothing active when death appears imminent is a duty the student has to learn, but in the primary treatment of head injuries in the stage of collapse, in military as in civil practice, there is no more stringent rule than to abstain from interference, to wait and to watch. The patient should be relieved of all unnecessary dress; no tight belts or garment being allowed to interfere with the respiration. He should be placed in the horizontal position, and when moved from necessity it should be done as gently as possible. When the extremities are cold, extra covering may be applied, and artificial warmth when possible.

As case develops.

As the case develops, its surgical treatment ought to be conducted on precisely similar principles to those laid down in former chapters. Practice is to be established on the preventive principle, to ward off intra-cephalic inflammation; perfect quiet, cold applications to the head, and liquid food being the three essentials. Foreign bodies are to be searched after and removed with extreme caution. When they have entered the skull, and still more the brain, all search is forbidden; but when situated at the external orifice they should be taken away, and the sooner the better. If a ball be so impacted as to be immovable, the wound in the broken bone may be enlarged to favour its extraction, but no unnecessary interference with the cranium or its contents should be entertained. All foreign bodies in the integuments outside the skull ought to be taken away as soon as discovered.

Of foreign bodies.

Trephining.

The opinion of most Surgeons is decidedly against the *operation of trephining* in gunshot wounds of the head. When the operation is entertained it should only be in compound fractures with depression attended with brain symptoms. The experience of the Crimean war, of our own as well as of French Surgeons—of the Schleswig-Holstein and Franco-Prussian wars as recorded by Stromeyer—of the Indian war as told us by Dr. Williamson, is, without doubt, decidedly against this operation. In the Crimean campaign, the trephine was only successfully employed in four out of twenty-eight cases in our own army, and among the French it was for the most part fatal.

The late American war, however, gives us a more favorable result, 85 recoveries to 115 deaths, but the report itself states that "the data are not sufficiently complete to admit of fair comparative analysis," so judgment must be withheld.

Removal of bone fragments.

In compound fracture, loose fragments may always be removed. In all penetrating wounds of the skull with lodgment of the projectile, operative interference is out of all question.

As a rule, writes MacCormac, "the largest proportion of good results will obtain amongst those cases where the amount of operative surgery has been at a minimum."

Summary.

By way of summary, it may be remembered, that cerebral concussion, rupture of one of the cerebral sinuses, and fatal intracranial hæmorrhage may take place from a gunshot projectile without any external marks of injury, and that a gunshot injury of the head followed by a scalp wound, without any cerebral symptom, may be followed by inflammation of the bone and meningitis.

The vitreous or inner table of the skull may be fissured, depressed, and even detached, without *any fracture* of the external table. The drawings taken from Circular VI of the Washington War Department, illustrate the fact (Fig. 604-5), such accident being probably the result of a small projectile striking the cranium very obliquely. Fissure of the internal table may also co-exist with a linear fissure of the external table.

A ball may gouge out a portion of the external table of the skull without injuring the cranial contents.

A fragment or the whole of a ball may partially penetrate the skull and fall out, or be retained, or pass through it; the wound of exit through the thickness of bone, or through the two sides being larger than the wound of entrance.

Penetrating and perforating fractures of the cranium terminate favorably in quite exceptional instances.

Hernia or fungus cerebri may take place after gunshot, as after other injuries, and recovery in these cases may occur, the experience of Surgeons in the American war clearly showing that this result is more likely to take place without than with compression or operative interference.

Trephining may only be undertaken with a fair prospect of success in local fractures with depression and brain symptoms; loose fragments of bone being always removed in all compound wounds.

Gunshot Wounds of the Chest.

Gunshot wounds of chest.

These are returned as one in ten among the officers and one in seventeen amongst the men in the Crimean war; about 30 per cent. of these died; in the American war the mortality was 73 per cent.

Non-penetrating.

Non-penetrating gunshot wounds generally recover, although they are slow in healing, on account of the natural movements of the ribs interrupting the process of repair. They are, moreover, apt to be followed by pleuritis, on account of the frequency of the ball taking a circuitous course beneath the skin round the walls of the chest. When the chest has been severely contused from a spent ball or a heavy fragment of shell, abscesses or even necrosis of the ribs are prone to follow the accident, and from the same character of accident where there is no fracture, the lungs may be injured, this result being likewise met with in young subjects in civil practice when the chest is squeezed. Professor Longmore states that "ecchymosis, or at least congestion of the lung itself, to a partial extent, in all probability follows every non-penetrating gunshot wound of the chest of much severity." The ribs may likewise be broken and driven in, as in the direct blows of civil life.

Penetrating.

Penetrating gunshot wounds are generally fatal, scarcely more than one in ten surviving, while death generally results directly from hæmorrhage, or from the consequences of secondary inflammation of the thoracic organs. The difficulties of diagnosis in these cases are as great as they are in civil practice, especially if the bullet be small and has entered obliquely near the scapula, or if the track of the bullet is covered by sound skin. "It is only," says Longmore, "by a combination of symptoms, rather than by the presence of any one or other symptom, that a lung wound, can in many instances be diagnosed." Penetrating wounds with lodgment of the ball are more fatal than perforating wounds, and a fracture of the rib at the wound of entry renders a penetrating wound more dangerous. When the lung has been wounded by a penetrating shot, shock, collapse, escape of air, hæmorrhage from the external wound and from the lung, hæmothorax and dyspnœa are characteristic symptoms. The *shock* is, however, frequently less in penetrating than in non-penetrating wounds when the latter are attended with general concussion. It is remarkable that a lung may at times be completely traversed by a ball, and beyond the hæmoptysis and dyspnœa of the first few days be followed by only the most trivial symptoms.

Wounded lung.

External hæmorrhage.

External bleeding in chest injuries is also said to be more commonly due to laceration of an intercostal or the internal mammary artery than to a wounded lung.

Internal hæmorrhage.

Internal bleeding is the chief cause of death, but the Surgeon has no means at his disposal to make out the exact source of the hæmorrhage. A gush of blood from the mouth indicates the opening of a large vessel, but in more chronic cases the sources of the bleeding may be pulmonary or parietal. "The situation of the wound of entrance, or the course the ball has taken, inferred from the relative positions of the wounds of entrance and exit, will greatly help to determine the probable site of the bleeding, and to some extent its probable degree of gravity. Internal bleeding from a wounded intercostal artery is very rare."

Gunshot wounds of heart.

Gunshot wounds of the heart are always fatal, although not always immediately. In a case recorded in Circular No. III of the War Department of Washington the patient survived fifty hours, the pistol ball having wounded the right auricle.

Treatment.

Treatment.—To arrest hæmorrhage, to remove fragments of bone or foreign bodies, and to do nothing that can interfere with nature's reparative processes, are the three great principles of practice to be observed. They are, indeed, precisely similar to those the civil Surgeon follows. In bleeding from an intercostal artery the best plan is to plug the opening, at least so says Professor Longmore. This may be done in the following way:—"A large piece of linen is laid upon that part of the chest in which the wound is placed, and the middle portion of this linen is pressed into the wound by the finger, so as to form a kind of pouch. This pouch is then distended by sponge or lint pushed into it until the pressure arrests the bleeding; on stretching out the corners of the cloth the pressure of the plug will be increased."

If the wound is not attended with hæmorrhage it should be cleaned and lightly closed, the side being strapped up to restrain movement. Hermetically sealing gunshot wounds of the chest is reprehensible. The patient should be laid on the wounded side with the wound downwards, to allow of the escape of discharges.

In all other respects, the treatment of gunshot wounds is similar to that of others, and the remarks already made are applicable to them. Venesection is less commonly employed now than it was by the Surgeons of the Peninsular war, and in the American war appears to have been abandoned. The dangers of inflammation of the contents of the chest are the chief source of the Surgeon's anxiety, and his aim ought to be to prevent them if possible, and when present to check them. Hæmorrhage should be treated by the application of cold, perfect rest, and the administration of opium. When empyema follows as a secondary result, a free outlet may be made for the accumulated fluid.

Gunshot Wounds of the Abdomen.

Gunshot wounds of the abdomen.

These are mostly penetrating, and non-penetrating wounds are often associated with some injury of the abdominal viscera. Longmore informs us that in the Crimean campaign, out of 115 non-penetrating wounds and contusions, 22 deaths occurred, these cases including those of injured viscera. When death follows a non-penetrating wound it is, as a rule, from sloughing of the abdominal walls.

Penetrating.

Penetrating gunshot abdominal wounds are generally fatal, nine out of ten of the Crimean cases, French and English, having been so recorded. In the American campaign the mortality was 74 per cent. Shock is always very great, and collapse from hæmorrhage the most striking symptom. This is, indeed, says Longmore, "sometimes the only symptom which will enable the Surgeon to diagnose that the viscera are perforated. The mind remains clear, but the prostration, oppressive anxiety, and restlessness are intense. Should life be prolonged, signs of peritonitis will soon appear."

In musket-shot wounds, it is exceptional for any of the abdominal contents to escape from the opening; but when they do the nature of the wounded viscus will be indicated. The swelling of the margins of the wound accounts for this fact.

Wounds of liver. Very fatal.

Wounds of the *liver* are attended with a large mortality, and are always complicated. Shock and hæmorrhage are the usual immediate causes of death; but when life is prolonged, peritonitis. Longmore saw only one case of recovery in the Crimea; while Dr. Otis records 4 recoveries, in America, out of 32 cases of this form of injury. In Circular No. III of the Washington War Department 4 cases of recovery out of 15 from this injury are recorded, and in one the gall-bladder was wounded. Wounds of the *spleen* are almost always fatal from hæmorrhage; and are generally complicated with other injuries.

Of spleen.

Of stomach.

Gunshot wounds of the *stomach* are not always fatal. They are made out to exist when the contents of the organ escape externally, or when, from the extent of wound, the viscus can be seen. They are always associated with vomiting of blood. Hennen records two good cases of recovery which occurred at Waterloo, and the well-known American case of Alexis St. Martin, reported by Beaumont, is another. Dr. Peters, of the United States Army, has also reported a case that occurred in the American war. Guthrie and Cooper give nine or ten others.

Treatment.

When the wound is incised it should be stitched up. Opium should be administered with nutrient enemata. Nothing should be given by the mouth for some days.

Gunshot wounds of intestines.

Gunshot wounds of the intestines are not necessarily fatal, although instances of recovery are rare. Wounds of the large are not so bad as wounds of the small intestine. Hæmorrhage, and, if not, peritonitis, is the usual cause of death. Longmore relates one case in which recovery took place. Dr. Hamilton, of New York (1865), quotes eight cases of fæcal fistula which terminated in recovery by natural processes, all having taken place in the late American war, and in the older writers many more might be found. Dr. Habershon has recorded a most interesting case of gunshot wound of the colon through the right loin, the patient dying four years subsequently from albuminuria ('Guy's Reports,' 1859).

Treatment.

Treatment.—Absolute quiet is the most essential point to be observed in these as in all other cases of abdominal injuries. The recumbent position should be enforced and maintained under all circumstances. Opium or morphia should also be given in repeated doses, no drug having a better influence in peritoneal inflammation. Absolute cleanliness of the wound should also be observed, but there should be no strapping or closing of the orifice. Simple nutritious food may be allowed and, as the case progresses, solids may gradually be taken.

Fæcal fistulæ appear to have a tendency to close by themselves. In the American cases they gave, in general, but little trouble in their management (Circ. No. 6, S. G. O., 1865).

Exploration of wound.

With regard to exploring the track of the wound the Surgeon should never forget, says Lidell ('American Quart.,' 1867), "that in the management of these cases, art, to be useful, must be the servant of nature, and must seek to do good by assisting her mistress in the efforts at repair, and not by the introduction of new and violent measures which are liable to aggravate the original injury." He believes that neither the finger nor any instrument should be used for exploratory purposes, except in special cases. Dr. Otis, however, in Circular No. III of the Washington War Department, issued in 1871, p. 87, says that "the mortality of these cases is so great as to furnish an additional argument in behalf of Legouest's proposition to incise the abdominal walls and explore the track of the projectile in certain penetrating wounds. Thus only can the patient exchange the probability of inevitable death for the possibility of recovery, either through the prevention of extravasation by enterorrhaphy, or the bringing of the wounded viscus into apposition with the abdominal walls. For one, I am free to assert that where there is evidence that internal hæmorrhage or fæcal extravasation is going on, what may be termed the 'ostrich plan' of giving opium and making the patient comfortable should be abandoned; and I believe that prejudices similar to those that ovariotomy has successfully overcome in the last quarter of a century will be dispelled by the results of exploratory incisions in gunshot wounds of the abdomen before many years have elapsed."

Leparotomy.

Wounds of bladder.

Gunshot wounds of the bladder do not appear to be so fatal as the cases of ruptured bladder met with in civil life. Lidell reports two such cases where a good recovery followed, the projectile in both having passed completely through the organ. Guthrie has related six, in all of which recovery took place. MacCormac records a case in which the ball passed through the rectum and bladder, the fæces for a time passing through the posterior opening, and the urine through the anterior. Both wounds closed by natural processes in seventeen days. In all of these the urine escaped externally through the wound made by the projectile, and thus prevented fatal peritonitis from taking place. Such instances as these indicate the proper practice to be pursued in all cases of ruptured bladder, viz. cystotomy, as for lateral lithotomy. When foreign bodies have been carried into the bladder they should be removed, as a ball may remain in the bladder and become the nucleus of a calculus. Guthrie, Hennen, Cheselden, and Garengeot have given such cases, and Ballingall has collected nineteen. In Circular No. III of the Washington War Department three cases are recorded in which calculi were removed which had formed on bullets; one where a stone had concreted upon an arrow-head, and one on necrosed bone.

Removal of foreign bodies.

Gunshot wounds of face.

Gunshot wounds of the face are serious from the fact that they are so frequently followed by secondary hæmorrhage; and, as the deep vessels are usually its source, the difficulties of controlling it are always great. When this complication does not destroy life, good recoveries take place, wounds of the face always healing kindly and with little scar. When there is much loss of tissue, some secondary plastic operation may be required, and many are the instances of success following this practice.

Of neck.

Gunshot wounds of the neck are serious according to the nature of the parts involved. When the large vessels and nerves are injured, a fatal result generally takes place; and when the larynx or trachea is implicated, the risks of suffocation are great not only from the direct result of the injury, but from secondary œdema; when this latter complication occurs tracheotomy should at once be performed. Wounds of the neck are very liable to be followed by septicæmia.

Wounds involving *the vertebræ* are usually fatal, those cases alone recovering where the spinous or transverse processes are the parts injured.

Of extremities.

Gunshot wounds of the extremities include flesh wounds and contusions, fractures which are rarely simple, and compound fractures, wounds of joints, and compound fractures into joints.

All these may be complicated with some injury to the vessels and nerves of the part, and the lodgment of foreign bodies or projectiles. Gunshot flesh wounds usually do well unless complicated with lesions of the vessels and nerves.

Causing fracture.

Fractures from gunshot wounds are sometimes simple, but more commonly compound. When *simple* they are generally caused by blows from spent balls or other projectiles, the bones usually being split or comminuted and contused, not rarely split vertically into a neighbouring joint, the soft parts equally suffering. When *compound* the same comminution and splintering of the bone is commonly present, associated with other complications, such as severe laceration of the soft parts, involving arteries, veins, or nerves, with their attendant dangers, lodgment of fragments, or the whole of the foreign body in the bone or soft parts, and some joint complication from the splitting of the bone into the joint, or from direct injury to the joint.

Partial fracture.

Military Surgeons, however, writes Professor Longmore (in 'Holmes's System'), meet with cases of partial fracture. "1. Removal of portion of a bone by the projectile making a furrow in its passage across its surface, grooving it. 2. Removal by splintering off longitudinal fragments from the external cylindrical part of a bone. 3. Removal of part of the bone by completely punching out a portion, thus leaving a hole through the entire substance of the bone. 4. Partial fracture by driving inwards part of the external cylinder, and causing the fragment to lodge in the cancellated structure, with or without lodgment of the projectile."

Complete fracture.

Resecting fractures.

Of complete fractures, the peculiarity consists in the comminution, and vertical splintering of the bone, and of the complete removal of some part of the shaft of the bone, the term "resecting fractures" being applied to such. One curious fact occasionally produced by the heavy conoidal ball is noticed in Circular No. VI of the Washington War Department, in which the bone is fissured and comminuted, though less than is common, at the point at which the ball impinges, while at two or three inches above or below this point a nearly transverse fracture of the shaft is produced. In some of the specimens the transverse fracture is not connected by fissures with the fracture produced by the ball. These injuries, probably, are due to balls fired at short ranges.

When conoidal bullets, writes Longmore, happen to strike on or below the trochanters of the femur they usually leave the head and neck of the bone intact, but cause fissures, which often extend to a long distance down the shaft; when they pierce the head of the bone all the parts below usually escape fracture; when the neck is perforated the fracture generally extends both upwards and downwards. The same rule holds good with regard to the upper extremity of the humerus, although not in so marked a manner.

Osteomyelitis in fracture.

In all these fractures, from the comminution of the fragments and the concussion the bone has sustained, osteomyelitis and septicæmia are liable to occur, as pointed out by Jules Roux, of Toulon, in 1860 ('Bulletin de l'Académie Impériale de Médecine'), and Longmore ('Med.-Chir. Trans.,' 1865). J. A. Lidell showed that gunshot contusions of long bones are more fatal from this cause than comminuted gunshot fractures ('American Journal,' vol. xlix).

Liability to pyæmia.

Fractures of the lower extremity are more liable to be followed by such blood poisoning than those of the upper, the susceptibility being much determined by the size of the venous canals; the larger and more numerous the veins of a part, the greater the danger of septicæmia.

In gunshot wounds of the pelvic bones Stromeyer believes the liability to pyæmia to be very great, and that cold and exposure favour its development.

Of upper extremity.

Gunshot fractures of the upper extremity are far less fatal than those of the lower. "Unless the bone be extensively injured by a massive projectile, or longitudinal comminution exists to a great extent, especially if also involving a joint, or the state of the patient's health be very unfavorable, attempts should always be made to save the limb."—*Longmore.* When the bone is much splintered an examination by the finger for foreign bodies or detached pieces of bone should be made and their removal effected. Sharp points of projecting spiculæ should be sawn off, the most dependent wound being extended when necessary, or a fresh incision made for the purpose in a dependent position when only one wound exists, the case being then treated as an ordinary compound fracture.

Treatment.

Excision of shoulder or elbow

If the shoulder and elbow-joint be opened, and the condition of the soft parts, vessels, &c., is not such as to necessitate amputation, excision of the joint should be performed, the experience of the American war, as of all recent campaigns, indicating this very strongly.

Gunshot wounds of the wrist too often demand amputation; excision is not expedient, and where the major operation is not imperatively demanded attempts to save the limb should be made.

The same remarks apply to injuries to the fingers and hand, and only such portions as are irreparably damaged should be removed; for the value of a piece of thumb and one finger, of whatever kind, is hardly to be over-estimated, and every effort should be made to preserve whatever parts can possibly be saved.

Of the lower extremity.

Below knee.

Above knee.

Gunshot fractures of the lower extremity are far more grave accidents than those of the upper. Longmore lays it down as a general rule that ordinary fractures below the knee from rifle balls should *never cause* primary amputation; while, excepting in certain special cases, in fracture above the knee, amputation is held by most military Surgeons *to be a necessary measure.*

Upper third of femur.

The special cases are gunshot fractures of the upper third of the femur, especially if it be doubtful whether the hip-joint is implicated or not; as in these the danger attending amputation is so great that the question is still open whether the safety of the patient is best consulted by excision of the injured portion of the femur, by removal of detached fragments, and trusting to natural effects for union, or by resorting to amputation.

The decision of the Surgeon must generally rest upon the extent of injury to the soft parts, the age, condition of the patient, and surrounding circumstances. If the femoral artery and vein have been divided any attempt to preserve the limb will certainly prove fatal.

Amputation at hip-joint condemned.

Amputation at the hip-joint for gunshot wounds is generally fatal; so fatal, indeed, that it ought only to be undertaken when the lower limb is so mutilated as to render it a necessity, or when the great vessels have been injured. When any doubt exists as to the probability of saving the limb the operation should be postponed, and undertaken, if necessary, as a secondary amputation.

The experience of all British and Continental Surgeons fairly endorses Longmore's conclusions, that in gunshot fractures of the thigh, while the propriety of practising conservatism in the upper third is clearly indicated, amputation is the safest practice in gunshot fractures of the middle and lower third.

M. Legouest, in an essay published in the 'Mem. of the Society of Surgeons at Paris,' believes that amputation at the hip-joint should be reserved for compound fractures complicated with injuries to the great vessels, and he advocates the postponement of the operation as long as possible.

Gunshot fracture of head of femur.

In gunshot fracture of the head of the femur, where the soft parts are not greatly injured or the bone comminuted, *excision* of the bone may be performed, the only case of recovery in the American war from such an injury being where this practice was adopted. In Circular No. III two such successful cases are recorded out of three, and they induce Dr. Otis to "add that these instances must place excision at the hip for gunshot injury amongst the established operations of surgery." Out of eighty-seven excisions at the hip for injury in America, eight recovered.

Of thigh.

In fracture of the thigh the evil of transporting a patient is so great that Stromeyer says, "I have, during the last campaign, lived to see what I expressed a desire for some years ago, when I wrote, 'Above all things it appears to me to be necessary that cases of gunshot fracture of the thigh should not be transported to a distance, but should be carried on a stretcher to the nearest house, and the treatment carried out there.'" He speaks most highly of the conservative treatment of all gunshot fractures. When operation is called for, primary measures should always be preferred both for amputation and excision.

Of leg.

In fracture of the leg, conservatism has even a better chance, that is, where the shaft of the bone is alone implicated; for when the knee is involved, amputation is generally held to be the rule of treatment. Excision should not be entertained, the results of experience condemning the attempt. Langenbeck in gunshot wounds of the knee recommends conservative treatment; amputation being alone required when the soft parts are severely injured and the bones shattered. He lays, also, the greatest stress upon the necessity of fixing the limb in some immovable apparatus, from the moment of the injury to its cure (the plaster-of-Paris splint being preferred), coupled with the application of ice to the part. In gunshot fracture of the shaft

Of knee joint.

of the leg bones not involving joints, the same rules of practice are applicable as have been laid down for the treatment of fracture of the humerus, &c.

Of ankle-joint.

In gunshot wounds involving *the ankle-joint*, amputation is the best practice. In exceptional instances where the injury is slight, that is, where the bone is simply split into the joint, an attempt to save the limb may be justifiable. Excision as a primary operation is not desirable; as a secondary one, where an attempt to save the limb has been made and failed, Langenbeck's experience is in favour of excision, nine out of eleven cases in which he did it after the Bohemian war having recovered; but to obtain this result, he asserts that the complete immobility of the parts involved by means of the plaster-of-Paris splint or one of its congeners is indispensable.

On amputation in gunshot fracture.

With respect to **amputation in gunshot fractures**, every Surgeon since Guthrie's time believes that the *primary* should, as a rule, be preferred to the secondary. This primary amputation should also be performed as soon after the accident as possible. There is no necessity to wait for the effects of the shock of the accident to pass away, and unless the collapse be very severe the hand of the Surgeon need not be stayed. When, however, the collapse is great, some little delay had better be observed, for it is then more than probable that some internal injury or other complication exists to prevent reaction.

Chloroform may be given.

Chloroform or any other anæsthetic may be used in military as freely as in civil practice. It has a powerful influence in preventing shock and allowing prolonged or double operations to be performed, which could not otherwise be undertaken, at least without extra risk. In military practice it should be remembered that a limb must often be sacrificed when in civil practice it might be saved; and that amputation is often substituted for excision on account of the impossibility of giving the part the necessary amount of absolute rest and the patient the attention that can only be found in a civil hospital, "for when active operations are proceeding, and it is necessary to carry the wounded to any distance, the advantage of early removal of shattered limbs is obvious, especially when means of rendering the limbs immovable during the transport are defective or the transport itself has to be conducted over rough roads or in unsuitable vehicles, and the hopes of success from conservative treatment are thereby reduced almost to zero."—*Longmore.*

Longmore's views.

Gordon's views.

Dr. Gordon, the British commissioner accredited to the French army in the late war between France and Prussia, informs us that the conclusions the bulk of Surgeons arrived at as regards amputation were, that it was more suited than excision or re-section when its subject had to be carried on with the army; that excision and resection were much more likely to be successful when practised in the upper than in the lower extremity; that excision of the knee, as a substitute for amputation in case of gunshot wounds of that articulation, has sadly failed; that the practice of conservative surgery in stationary hospitals furnishes no criterion of its suitability in movable hospitals, its requirements involving such attention from the Surgeon as can alone be fully carried out when there are comparatively few cases of severity to attend to; and that in many cases, where the limbs are saved, they are relatively of little use.

MacCormac's views.

MacCormac urges that the mortality after primary is so very much smaller than that attendant on secondary amputation, that this point cannot be too strongly insisted upon.

The 'Surgical History of the American War,' as prepared by the late Surgeon Otis and published by the American Government, is a mine of practical information on gunshot and other injuries incident to warfare.

OSTEOTOMY.

Osteotomy.

When, in 1870, Mr. W. Adams reported his first successful case of subcutaneous division of the neck of the femur for the cure of a deformity the result of some old hip disease, he introduced to the notice of British Surgeons an operation of great value and of wide application, and which under the name of "Osteotomy" has already won a high position in practical surgery. Mr. Adams, however, did not suggest the operation, but followed Langenbeck, who in the winter of 1852 first performed it, and later on applied it to cases of rachitic deformity of the legs and others. At the present time Adams's operation as first described, or with certain slight modifications, is the one employed for the rectification of deformities in most hip cases. In Ogston's and Macewen's operation for the cure of bad cases of genu valgum, osteotomy is fully recognised. In the division of curved or bent bones, the result of rickets, it is being performed constantly, and as a means of correcting the deformities due to badly united fractures or unreduced dislocations it has a bright future.

Its application.

Its safety.

Indeed, experience has fairly proved that bones deformed by accident or disease may be divided by the saw or chisel through a small skin wound with an amount of safety which is somewhat startling, and that the operation has apparently attached to it a smaller number of risks than many others of a so-called minor character.

Whether the saw or chisel be used is a matter of small importance, so long as either instrument is used carefully. For my own part I prefer the saw; it was the one I originally employed in my early hip cases, and I have greater confidence in dividing cleanly the bone I approach with the saw than with the chisel. When the saw is inapplicable, as in the division of bones above the ankle for badly united fractures, the chisel may be employed.

The wound must be kept clean during the operation, and for this purpose I hold with my left hand when grasping the bone operated upon a sponge fairly filled with warm iodine water, but carbolic lotion may be used instead. When the bone is divided and the limb brought into the required position, the wound may be closed and covered with iodoform or carbolic gauze. The limb should then be at once fixed by some immovable splint such as Croft's or other plaster-of-Paris bandage in the position in which it is eventually to be brought.

In the majority of cases repair goes on quietly and quickly, and in five or six weeks the required result is brought about. In exceptional cases suppuration has taken place in the line of bone section, and in a still fewer number one of the accidents appertaining to wounds, however trivial, has brought about bad results. Accidents to deep vessels have likewise been recorded, and in one a spiculum of the diseased bone perforated a large artery and necessitated a series of operative proceedings which ended sadly. Still all these evil results are very exceptional. They should, however, be remembered as warnings against Surgeons being too strong in their assertions of the absolute safety of the measure under consideration, and to remind them that interference with such tissues as living flesh, bone, and blood has its own dangers and risks, which exist in spite of the skill which may be brought to bear upon the case by the operating Surgeon, or the theory under which the treatment of the wound may be carried out.

Osteotomy as an extension of subcutaneous surgery to bones is a great advance, and if not practised rashly is a valuable operation. Its special application to special cases has received consideration in former chapters.

On Bone-setting.

Bone-setting.

Bone-setters have acquired a position in this country, and the fact must be accepted as conclusive evidence that Surgeons have in a manner failed to give to the public the relief that has unquestionably been given by their unqualified and so-called ignorant fellow-workers; rather than as an additional testimony to the acknowledged preference which a large number of the public undoubtedly have for the strong assertions and professed power of charlatans and quacks over the calmer views and less dogmatic dicta of the scientific school.

With this feeling I propose to consider briefly where it is that our faults lie and how it is that they are to be remedied. And, first of all, where is it that Surgeons have failed? That the failure belongs more to the surgery of the joints than anywhere else is a truism, for the favourite expression of the bone-setter, that he has "put in" what was "out" before, is a well-known phrase, and that the process of putting in is some sudden forcible movement of the joint in the way it should but would not go, with free movements of the joint in all possible directions, is a well-recognised form of practice.

The conclusion, therefore, is tolerably clear, that where success follows the bone-setter's effort, movement is given to a joint in which little or but impaired movement previously existed; and that this is effected by the breaking down of adhesions, either in the joint itself or in the muscles and soft parts about the joint. In fact, his operation consists in the sudden rupture or freedom of parts that forbade the free movement of the articulation.

Nothing need be said about the clicks, snaps, and sounds which are made to tickle the ears of the patients, and to make them understand how something that was out went into place, since these are only "tricks of the trade," adjuncts to the empiric's art, employed to secure the patient's belief in his assertions.

In one case a tendon, rigid muscle, or nerve, is doubtless freed where it was before fixed. In another an old adhesion, which gave pain when extended, is suddenly snapped. In a third, possibly some displaced tissue or slipped tendon is restored to its right place; some fibro-cartilage in a joint is replaced. In rarer cases, after fracture, some osseous union is broken through. In all, however, the result is the same; movement is given where before it did not exist, or free movement is acquired where painful movement was previously experienced.

Its dangers.

That there are evils connected with the practice the experience of general Surgeons could produce ample proof. The present writer has seen many ill results. In one, an impacted fracture of the neck of the femur, undergoing natural repair, was ruthlessly broken up and comminuted, and the man rendered an irremediable cripple. In another, an elbow which had been dislocated and reduced, and in which some stiffness followed, was hopelessly disorganized by rough and needless manipulation. A hip-joint undergoing a good cure with anchylosis, having been broken down, underwent suppuration, which ended in the death of a valued life which would otherwise have been spared.

These and more than these, speaking cases, illustrate the dangers of a practice which has much good in it if rightly directed, and likewise much evil if wrongly and recklessly undertaken, especially if undertaken without knowledge of or care for a scientific diagnosis before treatment.

It is, however, the Surgeon's duty in these, as in all other cases, to seize the good and avoid the evils of a practice which, doubtless by chance, at times does much good; and there is no doubt that, for fear of doing harm, Surgeons often let the good go, and thus allow their patients to pass into the hands of charlatans.

Its advantages.

He ought, therefore, in cases of stiff joint, more particularly after *sprains* and *injuries*, when all signs of over-action or inflammation have subsided, give an anæsthetic, and employ sudden forcible movement. He ought to guard against stiff joints in the treatment of those injuries by employing passive movements earlier in the progress of the case than he has been wont to do. He ought, in many obscure affections of joints and limbs, the result of twists, sprains, or injuries, for diagnostic as well as curative purposes, give an anæsthetic, and so manipulate the joint and limb as to discover if possible, and to dislodge or replace if present, what evidently interferes with motion at the time, and may continue to do so in the future.

In cases of limited disease of the joints there is no doubt, also, that much may be done to prevent stiffness and to correct it when present; but in such cases a great appreciation of the changes in and about the joint which preceded the stage of stiffness is all-important, first as a guide to know what prospects there may be of giving the movement that is so desired, and, secondly, as to the risks that must be run to obtain it.

When the anchylosis or stiffness has been brought about by a long series of joint changes any attempt to break down united parts must of necessity be difficult, futile, and dangerous in the extreme.

When it is probably due to some peri-articular inflammation the prospects of obtaining a good result are better. At the same time it is to be admitted that the ultimate results of breaking down adhesions about or in joints that are the result of disease, with the view of giving movement, are not satisfactory. Movement for a time may be secured, but the stage of immobility is again soon reached.

On the whole, by way of summary, it may be said that the stiffness of a joint following a sprain or injury may generally be treated with success by rapid manipulation, followed up by passive movements through the entire range of joint movements; whereas the stiffness of a joint due to disease can rarely be so treated without harm.

But in no case should forced flexion or movement be employed when any local signs of inflammation are present.

CHAPTER XXXV.

ANÆSTHETICS.

General remarks.

When Sir H. Davy's attention was drawn in 1798 to Priestley's nitrous oxide gas by Dr. Mitchell's theory that this gas "was the principle of contagion, and capable of producing the most terrible effects when respired by animals in the minutest quantities, or even when applied to the skin or muscular fibre," and when he with Southey, the then Poet Laureate, and Coleridge, the philosopher, inhaled it with sufficient frequency "to establish the fact that the gas possesses an intoxicating quality, to which the enthusiasm of persons submitting to its operation has imparted a character of extravagance wholly inconsistent with truth" ('Life of Davy,' by Paris, 1831), he little thought that he was then laying the basis of experimental investigations that were to form an epoch in the history of the world or rather of mankind, and to end in the introduction into practice of a new power, which, being of inestimable value to the general public, is of nearly equal value to the medical profession, and has been the means of revolutionising surgery to an extent which few are aware of; for the "most terrible effects" with which this gas was credited have been transformed into the beneficial effects brought about by anæsthetics.

Nitrous oxide.

Chloroform.

In the present work, I have neither space nor inclination to go fully into the history of the subject. To the works of Snow, Sir James Simpson, Sansom, Druitt, Holmes, Dr. Marion Sims, MM. Perrin and Lallemand, I must refer the reader for full particulars on this subject. I shall content myself by recording the fact, that Dr. Crawford W. Long, of Athens, Georgia, was the first Surgeon who, in March, 1842, performed a surgical operation while the patient was completely anæsthetized by the inhalation of sulphuric ether. Dr. Marion Sims ('Virginia Medical Monthly,' May, 1877), remarks, "That the honour of the first public and authentic trial of surgical anæsthesia, by the aid of means newly discovered, belongs to an entirely obscure dentist, Horace Wells, of Hartford, Connecticut" (M. Perrin), this dentist having employed Davy's nitrous oxide gas in dentistry in 1844 with an excellent result. In 1846, Morton, Wells' late partner, introduced into practice at Massachusetts Hospital the use of sulphuric ether, probably on the suggestion of Dr. Jackson. In 1847, our own Lawrence, of St. Bartholomew's, on the suggestion of a student, Mr. Furnell, now Principal of Madras Medical College, used chloric ether for the same purpose ('Holmes's Syst.,' vol. 5, Ed. 2), and in the autumn of the same year, Sir James Simpson gave to the profession the active principle of the chloric of ether, the chloroform, on the suggestion of Mr. Waldie, of Liverpool, and since then this drug or ether, separately or combined, has been in general use.

Bichloride of methyline.

Other anæsthetics, however, have been introduced, the bichloride of methyline being the most popular.

Their action.

Stages of anæsthesia.

How anæsthetics act upon the body is not yet determined, although it is tolerably certain that the ultimate result is absolute paralysis of the nerve centres, cerebral and spinal. To this end a patient passes through, *first*, a stage of cerebral excitement; *next*, cerebral insensibility and loss of sensation; *thirdly*, loss of voluntary motion; and, *lastly*, loss of reflex action, the brain losing its power before the spinal cord; absolute paralysis and anæsthesia existing only when both nerve centres are completely under the influence of the inhaled drug, the nerve supply of the respiratory and circulatory systems alone excepted. Indeed, it is upon this fact that the practical value of all anæsthetics is based, the Surgeon aiming at producing paralysis of the muscles of the trunk and extremities only, and not those of the respiratory or circulatory systems. In a general way there is a wide interval between the two effects; in exceptional instances this interval is abridged; in such the heart and respiratory system suddenly become affected; and it is under these circumstances that sudden death takes place.

How anæsthetics destroy life.

Chloroform, like many other drugs, does not act alike in all individuals, some being very susceptible to its influence whilst others are the reverse. Like all anæsthetics, it increases at first the force of the heart's action, although this effect is slight and transient, the heart acting with less than its natural force when complete anæsthesia is produced. When a patient is brought quickly under the influence of an anæsthetic the heart's action may be suddenly arrested, Brown-Séquard believing that under such circumstances "it is by the reflex influence due to the sudden irritation of the branches of the par vagum in the lungs that chloroform has killed in the very rare cases in which the heart's action had been stopped before the respiration" ('Lect. on Phys. of Nerv. System').

Cause of cessation of heart's action prior to arrest of respiration.

Moderate doses of chloroform tend to weaken the heart's action after their first stimulating effects have passed away, the respiratory act usually ceasing before the circulatory when death is the result. Thus danger increases with the degree of stupor produced.

Respiration usually ceases first.

Ether is said not to depress the action of the heart to the same extent as chloroform. Of late it has grown rapidly into favour, and it is said by its advocates to be more safe than any other anæsthetic. It should be given with sufficient freedom to bring the patient under its influence before the blood becomes saturated.

Ether. Advantages and disadvantages.

When the upper eyelid can be raised without muscular resistance and no muscular contraction is caused by touching the cornea, the patient is, as a rule, sufficiently under the influence of the anæsthetic for surgical purposes.

Guides to complete anæsthesia.

Respiration generally, but not invariably ceases before the action of the heart, and death may be due either to the failure of the heart's action or to that of the respiratory function.

After death, all the cavities of the heart are distended; the cases in which the left side is empty being only exceptional. Chloroform is more commonly fatal in the struggling stage than in any other.

Post-mortem observations.

Billroth asserts "that during the stage of excitement violent muscular efforts may give rise to apoplexy, especially in individuals with disease of the heart, rigid arteries, or emphysema. Of most consequence in this stage, however, are the contractions of the muscles of mastication and the posterior muscles of the tongue. By means of the stylo-glossi and the glosso-pharyngei the tongue is drawn spasmodically backwards, pressing the epiglottis down so as to close mechanically the aperture of the larynx. Such patients become blue in the face, and die suffocated, not through the direct action of the chloroform, but from the mechanical privation of air," unless the tongue be well drawn forwards, or chin tilted upwards.

Anæsthetics affect the brain of different people in as many ways as drunkenness. One will be quarrelsome, a second violent, a third sentimental, and others maudlin, melancholic, or merry.

In epileptic subjects, I have seen patients pass through some epileptic convulsions during their progress towards narcosis.

The best rules for the administration of chloroform, ether, or any anæsthetic are those given by the Chloroform Committee of the Royal Medical and Chirurgical Society of London, 1864. It was my privilege to act as one of the members of that body, and all my subsequent experience has convinced me of the value of the suggestions then laid down. I quote them in full with only a few modifications.

Rules for administration of an anæsthetic.

Rules relating to the Administration of Anæsthetics.

Anæsthetics should on no account be given carelessly or by the inexperienced; and, when complete insensibility is desired, the attention of its administrator should be exclusively confined to the duty he has undertaken.

Under no circumstances is it desirable for a person to give an anæsthetic to himself.

As to food.

It is not advisable to give an anæsthetic after a long fast, or soon after a meal, the best time for its administration being four or five hours after food has been taken.

Depression.

If the patient is much depressed, there is no objection to his taking a small quantity of brandy, wine, or ammonia, before commencing the inhalation.

Fresh air.

Provision for the free admission of air during the patient's narcotism is absolutely necessary.

Position.

The recumbent position of the patient is preferable; the prone position is inconvenient to the administrator, but entails no extra danger. In the erect or sitting posture, there is danger from syncope. Sudden elevation or turning of the body should be avoided.

Inhaler.

An apparatus is not essential to safety if due care be taken in giving the anæsthetic. Free admixture of air with the anæsthetic is of the first importance; and, guaranteeing this, any apparatus may be employed. If lint, or a handkerchief, or a napkin is used, it should be folded as an open cone, or held an inch or an inch and a half from the face.

To be given slowly.

Chloroform should invariably be given slowly. Sudden increase of the strength of the anæsthetic is most dangerous. Three and a half per cent. is the average amount, and 4½ per cent., with 95½ of atmospheric air, is the maximum of the anæsthetic which can be required; given cautiously at first, the quantity within this limit being slowly increased according to the necessities of the case, the administrator being guided more by its effect on the patient than by the amount exhibited. Ether may be given more boldly.

The administrator should watch the the respiration of his patient, and must keep one hand free for careful observation of the pulse.

When patients hold their breath, more air should be admitted; and when the movement of swallowing is seen, it should be accepted as evidence that the anæsthetic is stronger than necessary. On any sound of stertor fresh air should be admitted.

Vomiting.

The patient who appears likely to vomit whilst beginning to inhale the anæsthetic must be at once brought fully under its influence; the tendency to sickness will then cease.

Danger.

The occurrence, during the administration of an anæsthetic, of sudden pallor, lividity of the patient's countenance, or sudden failure or flickering of the pulse, or feeble or shallow respirations, indicates danger, and necessitates immediate withdrawal of the anæsthetic until such symptoms have disappeared. The chin should be raised as much as possible from the sternum, and if this movement fail to open the larynx the tongue should be pulled forward and the head drawn back.

Inversion of body.

Nélaton and Marion Sims advise the inversion of the body with the view of throwing what blood there is wholly to the brain, on the theory that death from chloroform is, as a rule, due to syncope, or to cerebral anæmia. In the more threatening cases, commence instantly with artificial respiration, whether the respiration has failed alone or the pulse and the respiration together. Galvanism may be used in addition to artificial respiration, but artificial respiration is on no account to be delayed or suspended in order that galvanism may be tried.

Artificial respiration.

Galvanism.

Laryngotomy.

In extreme cases laryngotomy may be required.

Few, if any, are insusceptible to the influence of anæsthetics, from two to ten minutes being required to induce anæsthesia. The time varies according to age, temperament, and habits.

Chloroform or A. C. E. mixture.

The mixture of alcohol 1 part, chloroform 2 parts, and ether 3 parts, which should be mixed fresh before use, should be given in the same way as chloroform alone, care being taken, when lint or a handkerchief is used, to prevent the too free escape of the vapour.

In Vienna the favourite mixture is three parts of ether to one of chloroform. Billroth employs chloroform three parts, ether one part, and alcohol one part.

Use of Anæsthetics in Surgical Operations.

Any person fit for a severe operation is a fit subject for an anæsthetic, but no one is so free from danger that care in watching its effects can be dispensed with. The cases requiring the greatest vigilance are not the young and delicate, for whom a small dose suffices, but the strong, who inhale deeply and struggle much. Ether is probably better for those suspected of fatty degeneration of the heart, although as a rule such cases are eminently satisfactory under chloroform.

Phthisis no bar.

In phthisis, when an operation is unavoidable, anæsthetics may be given with impunity.

For all operations upon the jaws and teeth, the lips, cheeks, and tongue, anæsthetics may be inhaled with ordinary safety. By care and good management, the patient may be kept under their influence to the completion of the operation. In these cases blood, as it escapes, if not voided by the mouth, passes into the pharynx. If any small quantity finds its way through the larynx, it is readily expelled by coughing. In operations upon the soft palate, fauces, pharynx, and posterior nares, if sudden or severe hæmorrhage is likely to occur, it is not advisable to induce deep insensibility. In cases requiring laryngotomy and tracheotomy, anæsthetics may be employed with safety and advantage.

As to its employment in ophthalmic operations.

For operations upon the eye, involving the contents of the globe, the use of anæsthetics is open to objection, on account of the damage which the eye may sustain from muscular straining or vomiting. If employed, profound insensibility should be induced. Recent experience tends rather to prove that anæsthetics may be used without fear in most eye operations.

In operations for hernia, and in the application of the taxis, anæsthetics act most beneficially. For most operations about the anus and perinæum, profound anæsthesia is positively demanded.

In shock. In the condition of shock or of great depression as after hæmorrhage, the careful administration of anæsthetics diminishes the risk of an operation.

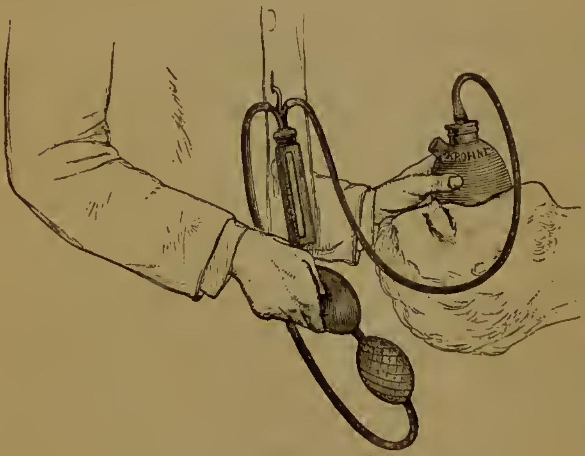
In all cases other than those specially referred to, it is sufficient to state, so far as a mere surgical operation is concerned, that anæsthetics may invariably be administered.

The continuous vomiting occasionally induced by and following upon the inhalation of anæsthetics, may be injurious by consequent exhaustion, as well as by mechanically disturbing the repair of a wound. With this reservation, they do not appear to interfere with the recovery of patients from surgical operations.

Statistics. Statistics.—The results of 2586 capital operations performed before, and of 1847 performed since, the introduction of anæsthetics, which I collected from all authentic available sources, show that the rate of mortality has not been increased, even though much graver operations Risk. have been done under the influence of anæsthetics. The risk attending the inhalation of chloroform is very small, being about 1 in 3000 administrations. This is enough to forbid its use in trivial cases, but not enough to do so in cases of capital operation, or where for purposes of diagnosis it is required. In children it is very safe.

Inhaler. The best instrument for the administration of chloroform I believe to be that of Junker (Fig. 606). In it a drop of chloroform vapour is vaporised by each full compression of the air-ball, and a stronger vapour cannot be given. It may be employed without the mouth-piece. If the ball is compressed before each inspiration no vapour will be lost. I use nothing but this in my own practice. The older instrument which I introduced at Guy's in 1864 (Fig. 607) is, however, portable and good. It is not complicated by any valves, but is merely a mouth and nose-piece lined with lint, with openings to admit air freely (Fig. 607). Within the last few years, Skinner's inhaler, composed of a framework of wire, covered with a layer of flannel, fastened to the frame by a gusset and tape, and a handle, has found much favour, and is very useful.

FIG. 606.



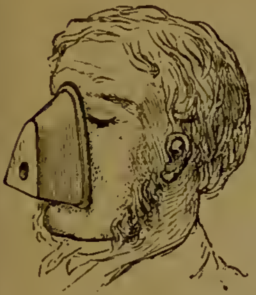
Junker's chloroform inhaler.

Clover's. Clover's apparatus is, however, very good when it can be obtained. It is composed of an india-rubber bag into which chloroform or any other anæsthetic is pumped, mixed with atmospheric air. Clover employs 3 or 4 per cent. of chloroform. It is, however, a cumbersome apparatus, and cannot be at universal command. When he gives nitrous oxide gas at first and follows it up by ether, his apparatus is equally satisfactory. For ether or the anæsthetic A. C. E. mixture the leather bottle-shaped apparatus, as suggested by Dr. Golding Bird, or the one figured above as made for Mr. Rendle and improved by Morris (Fig. 607A) is very valuable.

Bichloride of methylene.

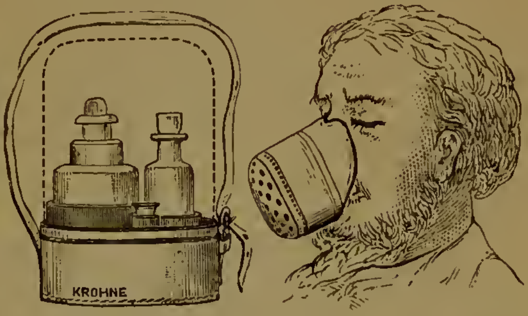
The bichloride of methylene is recommended to our notice as an anæsthetic of great power. Patients are said to be brought under the influence of the drug in twenty or thirty seconds, and to recover from it rapidly with little inconvenience. No sickness or headache is said to follow its use, unless the inhalation has been continued for many minutes, or a second dose is given to keep up the effect. Of course, if the inhalation be prolonged, the after-effects resemble, though in a less degree, those of chloroform, save the one—absence of muscular excitement.

Fig. 607.



Chloroform inhaler.

Fig. 607A.



Inhaler with bottles and strap complete.

Perforated inhaler as applied. Rendle's inhaler as improved by Morris.

Dr. Bouchut ('Gazette des Hôpitaux') recommends the use of chloral as an anæsthetic for children. He gives one dose, not exceeding forty-five grains, in children under three years of age. In half an hour the patient is asleep, and in an hour insensible. The anæsthesia lasts from three to six hours, and is followed by no unpleasant consequences. Thirty grains may be given without danger, Bouchut says, to children between two and five years of age ('Brit. Med. Journ.,' Nov. 16, 1878).

In abdominal surgery, such as ovariotomy, Keith has said that ether is less prone to be followed by sickness than chloroform, and if th eusccess of an operation is any argument in its favour, Keith's must be quoted.

A. C. E. mixture.

I have for some years employed the mixture recommendedby the Chloroform Committee—of Alcohol, Chloroform, and Ether—and think well of it. I believe it to be as good as chloroform, and less likely than any other to be followed by that bane of all anæsthetics, vomiting.

Nitrous oxide.

In the operations of dentistry and all short measures, the nitrous oxide gas is of great value.

After-treatment.

After the use of any anæsthetic, everything should be given cold for twelve or twenty-four hours to prevent sickness; ice, indeed, may be sucked with advantage; and ice and milk is a very favourite mixture. If hot food be given, vomiting is far more likely to appear, or to be aggravated.

Secondary Uses of Anæsthetics.

Anæsthetics as aids to diagnosis.

Anæsthetics, however, have other uses than the destruction of pain. As aids to diagnosis they are of priceless value, both to the physician and Surgeon. To the Surgeon they have also opened up new fields for his scientific art which were formerly but little known. I shall point them out, however, but briefly, quoting from a lecture I had the honour of delivering at the Hunterian Society in 1870:

In abdominal tumours.

"Chloroform as an aid to diagnosis stands second to no means which we have at our disposal. To the physician who has a difficult case of abdominal tumour, what facilities it gives him for its thorough investigation. Suspected tumours become phantoms; so-called movable kidneys slide away, and indefinite conditions become clear and intelligible. With how much greater certainty a physician can think over a doubtful case, decide upon its nature, deliver his opinion, and treat it when he has adopted this means of investigation. In hysterical subjects, it renders a thorough abdominal examination a possibility, when no such otherwise existed; and in what class of cases, may I ask, is it more necessary to make a positive diagnosis than in this? In my own practice it enabled me on one occasion to make out a pregnancy when an ovarian tumour had been diagnosed by men whose authority was undoubted, and in a patient whose position in life rendered the suspicion of pregnancy almost a libel. Indeed, the ovarian nature of the disease was looked upon as so decided, that my aid was sought solely for the operation. In this case an examination of the abdomen was impossible, from hysterical sensibility; but under chloroform all difficulties disappeared. To the physician-accoucheur may I not also assert it to be equally valuable for diagnostic purposes? To answer this fully is out of my province; but I have known a case of cystic disease of the uterus, which was about to be operated upon as an ovarian tumour, made out by the use of the uterine sound, with the patient under chloroform, when an examination by the same instrument made before had failed to yield any such evidence. In the surgical diseases of children is it possible to over-estimate its value? With what gentleness can difficult examinations be now made of injured limbs; and with what certainty can we now apply our treatment! In sounding for stone what facilities it affords! In general surgery what new fields has it not opened? Would nephrotomy or nepbrectomy have been entertained? Where would ovariotomy have now been, may I ask, had not chloroform been in use? Would it have been an established operation in surgery? Could it have been so successful? The answers to these questions, I think, are plain; they must be in the negative. It is true the operation had been performed before its introduction; it had been successful in a few cases, but it had almost fallen out of practice; its revival was due, without doubt, to chloroform, and its present established position to the general use of that drug. No operation requires more gentleness and nicety; and how could these essential points of practice be applied with a patient writhing under the agonies of an abdominal section? To all abdominal surgery the same observations are applicable, although they may not tell, perhaps, with the same force. Without anæsthetics could Bigelow have perfected his rapid lithotrity? and would Thompson have practised so boldly his operation of cystotomy for the removal of bladder tumours?

In children.

"Let us now refer to another class of cases—to that large one known as belonging to plastic surgery. How many cases of vesico- or recto-vaginal fistula were successfully treated by operation before chloroform was introduced? At Guy's Hospital I can find no record of such. The physician-accoucheur used to cauterise the margins of the fistula, it is true, but, I fear, with poor success; for I have never heard of a case of any size being so cured. At the present day these cases are now to be cured by operation with as much certainty as any other class. They have, in truth, been moved from the incurable to curable affections. And yet these instances of plastic surgery are only a portion of those which I might enumerate.

In plastic surgery.

"In the treatment of deformities about the mouth, nose, and eye; in the division of cicatrices after burns; in the treatment of ruptured perinæum, with all its complications—what innumerable cases might be quoted now, against the few of former times!

"Again: in the operations of bones and joints, how many of the improvements in our practice are there that may not be put down to the use of chloroform?—operations for necrosis in particular. How rare these were, and how unsatisfactory they must have been before its introduction! I can recall a few which I saw in my student's days with no pleasant feeling. How common they are now, and how successful! Taking Guy's as a type of the metropolitan hospitals, an operation for necrosis can always be found for operating days—the operation is so frequent and so satisfactory. In the removal of bone from joints, in the excision of joints, it is only fair to believe that a great part of the success which now attends the practice is to be attributed to the use of an anæsthetic. How many hands and feet, which would formerly have been sacrificed, are now saved by the removal of diseased bone, it is difficult to estimate. Would Sir W. Fergusson have framed the phrase 'conservative surgery,' and could it have been adopted, before the introduction of chloroform?

In bone operations.

"In the treatment of aneurisms have not like improvements to be recorded? Has not chloroform rendered possible the cure of aneurism by pressure? Has it not also rendered the practice of torsion of arteries for the arrest of hæmorrhage a practical success, thus simplifying surgery? How many cases of strangulated hernia are now reduced, which in former times would have been submitted to strange treatment and to a delayed operation? How simple it has comparatively rendered the reduction of recent dislocations. Where are now the pulleys, the ropes, and the other frightful mechanical appliances, that were used of old for the reduction of dislocations of the hip, shoulder, and other joints? Are they not decaying in the lumber-rooms of our hospitals; and has not the use of chloroform made the reduction of dislocations by manipulation a reality? On one occasion I reduced with ease, by manipulation, a dislocation of the elbow-joint backwards, complicated with fracture of the humerus, which would probably have been left unreduced before the introduction of the anæsthetic, and more recently the head of the humerus dislocated on to the dorsum of the scapula, complicated with fracture through the tuberosities.

In aneurisms.

Strangulated hernia.

Dislocations.

"Let us contrast for one moment the operation of perineal section for stricture as it was and is now performed. Do we not all remember it as one of the most unsatisfactory and unsuccessful of surgical operations? Do not we know it to be one of the most satisfactory and successful? Indeed, I might continue the contrast between the pre-anæsthetic period and the present; but I think I have said enough to show that to the introduction of chloroform many of our best improvements in surgical practice are to be attributed. For the Surgeon it does away with all excuse, if any ever existed, for hurry in an operation. He can take his steps in it with deliberation, and make it a certainty. We never see now, happily, a theatre full of spectators observing the operation watch in hand; and I trust there are few, if any, Surgeons who at the present day sacrifice safety and certainty in their operations for expedition and display. The use of anæsthetics has rendered the practice of surgery safer, surer, and more scientific. It has removed difficulties from the practice of our art which before were insurmountable, and has rendered possible innumerable things that could not in former times have been entertained."

Local anæsthesia.

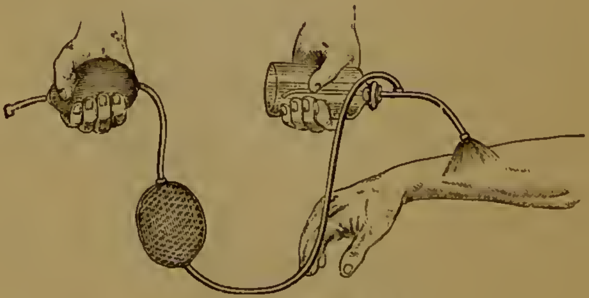
Arnott's method.

Richardson's.

Local anæsthesia may be brought about by freezing a part, as suggested by Dr. J. Arnott, or by means of the rapid evaporisation of pure anhydrous ether, as practised by Dr. B. W. Richardson. Both are valuable means of diminishing pain where anæsthesia by inhalation is forbidden or inapplicable. Arnott's plan is carried out by mixing up finely pounded ice in a gauze net or thin translucent india-rubber bag, with half its bulk of powdered salt, the net being placed over the part to be benumbed. If well applied, it renders the skin at once pale and bloodless, and if continued, of a tallowy death-like aspect; when too long applied it may produce frost-bite or chilblain.

Dr. Richardson's ether spray is a more elegant, as it is a more effectual, mode of applying local anæsthesia than ice. It is worked by his well-known apparatus, consisting of a tube with india-rubber ball and second spring ball to make the current continuous, the air being pumped in through this tube into a bottle containing anhydrous ether of a sp. gr. 0·723 and of a boiling point of 96° Fahr. Through the stoppered neck of this bottle a glass tube is passed, which reaches at one end nearly to the bottom of the bottle, and at the other, is fitted with a point, with one or more perforations through which the ether is forced in a fine spray, this spray being directed upon the part to be benumbed (Fig. 608).

Fig. 608.



Dr. Richardson's apparatus.

Where applicable.

For opening abscesses, taking out small tumours, the removal of external piles, and other minor operations, this local anæsthesia is of great value; but in graver surgical acts, it is inapplicable, as it only affects the surface and is but skin-deep in its influence.

CHAPTER XXXVI.

AMPUTATION.

General remarks.

When a limb is saved by the excision of a joint, and life prolonged by the application of a ligature to, or the torsion of a wounded or diseased artery, surgical science claims a triumph; and surely an equal triumph ought to be accorded to her, when, by the removal of a part that interferes with its duties, life is rendered more valuable; or by the amputation of a limb that is irreparably injured or diseased, death is averted. To say that amputation is an opprobrium of our art is to take a narrow view of its objects, since as the first object of the Surgeon is *to save life*, the necessary sacrifice of a limb becomes the truest "*conservatism*." To sacrifice a limb unnecessarily is an error which the surgical mind would never willingly commit, although to sacrifice life in the feeble effort to save a limb is one of far greater magnitude. It is an error, however, that timid Surgeons are too likely to fall into when inoculated with the narrow views of a spurious conservatism, since to leave a limb alone with the hope of saving it is a passive act of the professional mind that requires no effort; while to make up the mind to act requires courage backed up with knowledge and a full sense of responsibility. The operation of amputation itself requires nicety and well-applied mechanical skill; but to determine upon its necessity or otherwise requires a high order of knowledge, a careful balancing of probabilities, and much decision.

It is not my intention to discuss, in the present chapter, the conditions under which amputation may be called for, since these have been fully considered in the different chapters devoted to such injuries and diseases as may require this treatment. I propose simply to consider amputation as an operation, to point out the best modes of its performance under the different conditions in which it may be demanded, and to describe the various forms of operation as applicable to different parts.

Its history.

To supply the history of amputation would be an interesting but a too extended process. In 'Cooper's Surgical Dictionary' and 'Holmes's System' two able articles will be found upon the subject which contain all that can be desired. For the present purpose it will be enough to state that the first amputations were performed by the *circular method*, the soft parts being divided down to the bone by a circular sweep of the knife (*vide* Celsus), the hæmorrhage being arrested by the red-hot iron, and the bone divided by a saw.

Circular amputation.

About 1718 J. L. Petit, the French Surgeon, who improved the tourniquet now known by his name, as well as our own great Surgeon, Cheselden, suggested that the skin and fat of the limb to be removed should be first cut through and retracted, and then the muscles and bones divided as high as they were exposed. Still later, Louis, of Paris, adopted the practice of dividing by the first cut the skin and superficial layer of muscles, by the second, the deeper muscles down to the bone, at the line of the retracted superficial layer, and lastly, the bone itself. He also used a retractor.

By double incision.

In 1779, Alanson, of Liverpool, made a still further advance by cutting the integument as usual and allowing it to retract, and then dividing the muscles obliquely upwards, cutting from without down to

Circular skin, oblique section of muscles.

the bone, more after the modern flap operation, the bone being subsequently divided. The soft parts in this operation on being brought down formed a conical cavity with the bone at the apex, Alanson's object having been to prevent the sugar-loaf stump. Still later, Benjamin Bell, of Edinburgh, and Hey, of Leeds, secured the same end by first dividing the integument with a circular cut and dissecting it up; then the muscles at a higher level; and, lastly, the bone, this being divided at a point considerably above the line of the retracted muscles. Hey, moreover, in the thigh amputations suggested the expediency of dividing the posterior muscles longer than the anterior, to compensate for their greater retraction.

Flap operation.

Skin flap.

Skin and muscular flap by transfixion.

The *flap operation* is more modern than the circular, and to Mr. James Young, of Plymouth, is due the credit of having first published in 1678, the method which he informs us he had "from a very ingenious brother of ours," Mr. C. Lowdham, of Exeter. He made one flap only of skin, divided the muscles by the circular plan, and stitched the parts together. Eighteen years later Verduin, of Amsterdam, made the first muscular and skin flap by perforating the limb and cutting outwards (transfixion).

Amputation by skin flaps and circular muscles.

To Liston must be attributed the credit of having fully established the flap operation, and in the pre-anæsthetic period when time was a point of consideration, the expedition with which amputation could be performed by transfixion compared with the tediousness of the circular operation tended much towards this end. It was thought, moreover, that a large mass of muscle formed a good covering to the bone, and yielded a better stump than that in the circular. Experience soon proved, however, that this opinion was not supported by facts, that the supposed advantages were not real, and did not compensate for the larger extent of wound caused by the flap operation, and for the evil of often having to tuck in the projecting ends of the divided muscles before the integuments could be adjusted. Liston saw this before he died, and was led with Syme to modify his operation, making in muscular subjects two lateral crescentic skin flaps with their convexity downwards and dividing the muscles as in the circular method. This operation is by far the best for all amputations of the leg and forearm.

Long anterior flap.

In more modern times, Lowdham and Young's practice has found expression in Carden's operation, while Teale's amputation must be regarded as a modification of the flap. Both these gentlemen, however, advocated the long anterior flap in preference to all others, Teale making two rectangular flaps of unequal length of skin and muscle (Fig. 614), and Carden, a rounded anterior flap of skin alone (Fig. 615); and under certain conditions, nothing can be better than the results obtained, the line of cicatrix being posterior to the extremity of the stump and out of harm's way, thereby allowing the patient to rest part, if not all, his weight upon the stump.

Objections to the operation

The chief objections to the operation consist in the tendency there is for a long skin flap to slough, and the necessity of dividing the bone at a higher level than would be required in the circular operation, when a long flap cannot otherwise be made. In muscular subjects this last objection is serious, and fatal to the operation in many thigh amputations; for it is a truth that cannot be too forcibly recognised that in the thigh, the danger to life is increased with every inch of bone removed. The Surgeon who invariably practises Teale's amputation will often sacrifice a large portion of a limb that might otherwise be saved, and have to amputate at a higher point than the necessities of the case demand, thereby often adding to the danger of the case as well as performing a needless and unjustifiable operation. The Surgeon who removes such portions of the body as require removal and no more, by such a flap as allows the cicatrix to be placed behind the stump and out of harm's way, performs a good and scientific operation.

Requisites for a good operation.

Under all circumstances, any form of amputation must be looked upon with favour that takes away *only* what needs removal, and provides sufficient integument to cover the end of the stump; that ensures the cicatrix being out of harm's way, and that no nerves are likely to be involved in the cicatrix, or fixed to the end of the amputated bone. Any form of amputation must be regarded with disfavour that requires the removal of more of the body than is essential to carry out the Surgeon's primary aim, and increases the risk of the operation, however good may be the stump secured. To provide sufficient integument to cover the stump is a wise and necessary measure, and to fail in this when circumstances do not compel must be regarded as bad surgery; yet in certain cases of injury, disease, or gangrene of the extremities, where it is advisable to take away the diseased or injured parts, and no sound skin is left from which to make a flap, amputation should be performed without regard to a covering for the stump, as doubtless it is better to remove the diseased part that is hastening on the end and leave the stump to granulate, than allow the disease to have its way and to sacrifice life. At the hip- and shoulder-joints, where this contingency is most likely to occur, the adoption of this practice is not rarely called for, and at other parts is equally applicable; for, knowing what good stumps are often obtained when the skin and soft parts, that at the time of the operation covered in the bone, subsequently sloughed, I am convinced that in certain injuries to the arm and leg the Surgeon had better amputate with a poor flap at the elbow- or knee-joints, leaving the rest to nature, than risk life by amputating higher up, *i. e.* through the shafts of the humerus or femur. I have on many occasions acted on this principle, and to prevent the necessity of amputating above a joint in order to make a good stump with a skin covering, amputated at a joint or below, utilising even injured skin or bruised tissues, and rarely have been disappointed in the result, the stump subsequently granulating well, even when the flaps themselves sloughed. In injuries to the leg this point is of great importance, since the mortality of amputation of the thigh for injuries is very great. As an admirable illustration of the value of this practice a case may be referred to (Circ. No. iii, Washington Army Depart., page 216) in which recovery ensued after all four limbs of a man æt. 26, were amputated on account of frost-bite. A month after the injury, when the line of demarcation had exposed the bones, Dr. Muller, in order to save loss of blood which would have been serious in the patient's weak condition, dissected as much healthy flesh from the radius and ulna as the line of demarcation would admit, without cutting any blood-vessels, and then sawed through the bone. This operation was performed on both arms with hardly the loss of any blood. On the third day both legs were amputated in the same manner. In this case not one of the four stumps

Sacrifice flaps rather than amputate higher than necessary.

Example.

could be covered with sufficient skin, and much had to be left to self-reparation, which took place to an extraordinary extent, the stumps healing over with healthy granulations, some little exfoliation of bone taking place in two.

Not necessary to amputate always through healthy tissue.

Again, is it always necessary to amputate through healthy tissues? or, to gain this end, is it expedient to amputate higher up than would otherwise be necessary? I unhesitatingly answer that such practice is not called for. To amputate through tissues infiltrated with cancer or other new growths, would, of course, be futile and bad surgery; but to cut through tissues that are merely infiltrated with inflammatory products, that are pathologically reparable and of use, is a wise and conservative process. In disease of the knee-joint when suppuration has spread up the thigh into the soft parts, amputation may often be performed through the condyles or just above them, and a good stump secured; when by following another practice, a much higher amputation would be called for, and consequently, increased risk to life incurred. Tissues infiltrated with inflammatory lymph often unite rapidly and well; indeed, I have seen "brawny flaps" unite by primary union quite as well as others not so infiltrated.

Union of brawny flaps.

Character of stumps.

Relative mortality of different amputations.

Effects of a gross mortality.

No sacrifice of parts for sake of stump.

I am convinced, too, that however desirable it may be to obtain good, long, and healthy flaps in all amputations, the advantages of such are not so great as to justify the Surgeon in sacrificing more of the body than is essential, thereby adding to the risks of the case, and more particularly in amputating above a joint. It is true that by one form of amputation, a better stump under most favorable circumstances is often secured than another; but it is equally true that *good* stumps are often obtained under the most unfavorable conditions, and that *bad* stumps follow the amputation of a limb in which the state of the flaps promised to bring about a favorable result. To assert that the form of amputation, or rather that the shape of the flaps, &c., has anything to do with the relative mortality of different amputations is incorrect. What evidence exists points to a different conclusion, for the success of an amputation as of any other operation, turns more upon what in recent times seem to have been forgotten, viz. the conditions of the *viscera*, the *age*, and general state of the subject, accepting the facts that the older the patient the greater the danger, and the more of the body that is removed the greater the risk. My own conviction is, that however desirable it may be to obtain a model stump, the end is not sufficiently certain or important to justify the Surgeon in adding one tittle to the risk of the operation, or in sacrificing more of the limb than the necessities of the case demand. I regard it as bad and unjustifiable surgery to perform a Syme or a Pirogoff's amputation when a Chopart's will suffice; to amputate a leg when the removal of a foot at the joint will answer the purpose; to remove a leg or thigh an inch higher than is absolutely called for, in order to execute what may be looked upon as a good operation or to gratify a fancy; to amputate through the condyles of the femur when an amputation at the knee-joint can be performed, or through the shaft of the femur when the like end may be secured by cutting through the condyles. The Surgeon must ever look upon the operation of amputation as an unfortunate necessity, and should bear in mind that it is to be undertaken only to save or to prolong life, or to add to life's usefulness.

With these ends in view, he should not add one jot to its dangers, or take away an inch more of the body than is essential. The beauty of a stump may be something in itself, but is nothing if it is to be obtained by increased danger, and the brilliancy of an operation is a snare that should never be allowed to draw the Surgeon away from the main object—the preservation of life—which alone gives the operation of amputation a high and scientific position in surgical practice.

Mortality determined by age.

The mortality of amputation is more determined by age than anything else, and the credit of having statistically proved this fact is due to Mr. Holmes ('St. George's Hosp. Rep.,' 1866 and 1877). In my own paper on the causes of death in amputation ('Med.-Chir. Trans.,' vol. xlii, 1859) this point was overlooked; but, following Mr. Holmes's example, I re-analysed the cases on which it was based, and have been somewhat startled at the very definite conclusions brought out by my analysis. Thus—

Statistics.

Out of 103 cases under 20 years of age, 10 died, or 1 in 10.
Out of 111 cases between 21 and 40 years of age, 21 died, or 1 in 5.
Out of 74 cases over 40 years of age, 22 died, or 1 in 3½.

The mortality of amputation between the ages of 20 and 40 being exactly twice as great as before 20 years of age.

Mr. Callender ('Med-Chir. Trans.,' vol. xlvii, 1864) and Mr. Holmes's combined statistics reveal the same results:

	Cases under 20 years of age.	Between 20 and 40 years of age.	Over 40 years of age.
Callender's . .	61 cases, 3 died	92 cases, 20 died	74 cases, 30 died.
Holmes's . . .	130 ,, 22 ,,	215 ,, 68 ,,	155 ,, 68 ,,
	191 cases, 25 died, or 1 in 7½.	307 cases, 88 died, or 1 in 3½.	229 cases, 98 died, or 1 in 2⅓.

Fifty-two deaths having occurred in 250 cases reported by Mr. Holmes in subjects under 30 years, and 106 deaths in 250 cases operated upon after 30 years of age.

By age and causes.

If the causes of amputation are looked at in the same light, the results become still more marked, for, dividing them into amputations for disease, accident, and expediency, the latter term including amputations for tumours, deformity, &c., the following facts are elicited:

	Diseases.		Expediency.		Accident.	
	Cases.	Died	Cases.	Died.	Cases.	Died.
Under 20 years of age .	68	4, or 1 in 17.	9	3, or 1 in 3.	26	3, or 1 in 9.
Between 20 and 40 .	66	12, or 1 in 5½.	15	4, or 1 in 4.	30	5, or 1 in 6.
Over 40	33	5, or 1 in 6½.	9	3, or 1 in 3.	32	14, or 1 in 2⅓.

Amputation for acute suppuration very fatal.

Amputations for *acute* suppurative disease are most fatal, and should only be undertaken when a strong necessity exists. I pointed this out in 1859, but it is not a fact sufficiently recognised.

For chronic disease in children most successful.

Amputation in young life for chronic disease is most successful, being three times more so than at a later period, one only in every seventeen dying; amputation for accident increases in fatality with age; and amputations of expediency are as dangerous at all periods of life as traumatic amputations are in the aged.

Mortality in country and town cases.

Mr. Callender has also well shown ('St. Barth. Hosp. Rep.,' 1869) that the mortality of amputations is much alike, whether performed in country hospitals, in country private practice, or in country cases in London. In amputations on London subjects, as in the subjects of all large towns, the mortality is somewhat higher.

Dr. Steele has, however, gone further, and proved by figures, that amputations performed in London for injury on country patients are, as a rule, more favorable than when performed in town cases, the difference between the two classes being far less marked in amputation for disease than for injury ('Guy's Hosp. Rep.,' 1869-70).

Causes of death.

The causes of death after amputation are as follows, taking these conclusions from my paper on the subject ('Med.-Chir. Trans.,' 1859), to which the reader must be referred for further detail. *Shock and exhaustion* claim one third of the fatal cases, and one twelfth of all amputations. *Pyæmia* was the cause of death in 42 per cent. of the fatal cases, and in one tenth of all amputations. *Secondary hæmorrhage* in 7 per cent. of the fatal cases or 1½ per cent. of the whole number. Some *complication*, cerebral, thoracic or abdominal, causes death in about 4 per cent. of all cases. Pyæmia is nearly twice as fatal after amputations of expediency as after those for disease or primary amputations, but is less fatal after secondary amputations than any others. In amputation of the leg it is twice as destructive as in that of the thigh, the larger section of bone being the more dangerous. In primary amputation of the leg it is more fatal than when performed for disease.

Secondary hæmorrhage after torsion.

Statistics of cases of torsion.

How far the deaths from secondary hæmorrhage will be diminished when the practice of torsion of arteries is more general remains to be proved, although from the experience we have had at Guy's Hospital the promise of a better result is very great. Up to the end of 1874 we have had 200 consecutive cases of amputations of the thigh, leg, arm, and forearm, in which all the arteries had been twisted (110 of them having been of the femoral artery), and no case of secondary hæmorrhage—indeed, our house Surgeons never expect to be called to cases of secondary hæmorrhage now that torsion is the general practice of the hospital.

Double amputations.

Double amputations are of grave import and are very fatal. They are mostly undertaken for "smashes" or bad compound fractures. Out of 18 cases collected by my dresser, Mr. W. Blight, from the Guy's Records, I can, however, record 5 successful cases, or 27·7 per cent. of the whole number. One occurred in my own practice in a woman æt. 35, who had a Syme's amputation on one foot and a Hey's on the other. Two occurred in the practice of Mr. Durham, and both in men. One æt. 18, amputation of both thighs, and the other æt. 19, amputation in one thigh and forearm. Mr. Davies-Colley took off both legs of a boy æt. 8, with a good result, and Mr. Jacobson took off one leg in the thigh and one below the knee in a man æt. 30, with a like result. Thirteen cases died soon after the operation.

Amputation when called for.

Different forms.

The operation of amputation may be called for on account of some incurable disease or incurable injury. When performed for the first cause, the operation has been described as a *pathological* amputation, when for the second, *traumatic*. Both classes are also subdivided, the pathological into amputations for suppurative disease of bones and joints—pure *pathological* amputation; and into those for talipes, tumours, deformities, &c.—amputations of expediency.

Traumatic amputations performed during the first twenty-four hours after the accident before any inflammatory complications have set in, are called *primary*; the term *secondary* is applied to the same class of cases after suppuration has appeared; the word *intermediate* being employed to designate amputations performed twenty-four hours after the accident, but before suppuration has declared itself. This distinction, however, is not a satisfactory one. Traumatic amputations.

Some statisticians have classed the secondary amputations with the pathological, but this practice is clearly wrong.

The Different Modes of Amputation

may be divided into three great classes—1st, the *circular*; 2nd, the *flap* operation, whether by transfixion or cutting from without inwards—Teale's amputation (consisting of one long anterior skin and muscular flap, and short posterior), being looked upon as a modification of the ordinary flap operation; 3rd, the *mixed form* of amputation—skin flap, and circular cut through muscles—Carden's operation being included in this series. Into one or other of these classes almost every form of amputation may be brought, although practically there are innumerable modifications of each, more particularly of the flap. Various forms of amputation.

The old circular, as already described (p. 570), is now fairly abandoned. It has no advantages over the more modern mixed form of amputation, and will not take the place of the flap where the latter is applicable. In small limbs, where there is but little muscular tissue and a single bone to divide, it may be performed, but cannot be recommended. It is more practised abroad than in this country. The old circular operation.

The flap operation doubtless owes its popularity as much to Liston, Lisfranc, and Velpeau, who were its strong supporters, as to the facility with which it is performed, and the satisfactory appearance of the flaps at the time of the operation. Before anæsthetics were introduced, expedition was of importance, and it was the Surgeon's aim to remove a limb as rapidly as possible. "The Surgeon operating by the watch took off a limb by the flap operation in as many seconds as there were minutes occupied in the old circular method."—*Sir W. Fergusson.* Since 1846, however, when anæsthesia came into vogue, this necessity has ceased to exist, and Surgeons have been led away more from the flap operation to what may now be described as the mixed. The flap method.

In certain parts, however, the flap operation still holds its ground, and in a general sense it may be said that in operations where *the shafts of single* bones or some joints are involved, it is the best method; while in some localities, as at the shoulder- and hip-joints, it is the only one open to the Surgeon.

The objections to the flap operation are the large surface that is exposed, the danger of puncturing or slitting the main artery of the part, the inconvenience of bleeding, the leaving of the main artery and nerves in one of the flaps, and the disadvantage of a thick muscular flap. Its disadvantage.

The flap amputation has, however, one great advantage, and that is, its capability of innumerable modifications. Thus, both flaps may be made by transfixing—the old plan; both may be made by cutting from without inwards; one flap, the anterior, may be made by the latter method, and the second or posterior, by transfixion; or lateral flaps, single or double, or oval flaps, may be made. An advantage.

Advantages of transfixion. Disadvantages. Cutting flaps from without inwards.

The *advantages* of transfixing the flap consist in the rapidity and cleanliness with which the section of the muscles and deeper parts is made; its *disadvantages*, in the irregularity with which the skin is too often divided from the elastic integuments stretching before the knife. By the plan of cutting the flap from without inwards, this disadvantage is, however, neutralised, while an extra advantage is gained, for the Surgeon can often cut a longer skin than muscular flap, which in large limbs is a matter of importance.

In some amputations, as of single bones, the operation may be performed by cutting the anterior flap from without inwards, and the posterior by transfixing. In the arm and thigh, when I select the flap amputation, this method is that which I usually adopt. In cutting the flap by transfixion, particularly in the thigh, the Surgeon should always support it with his left hand, and, when a sufficient flap has been made, cut sharply outwards (Fig. 610).

Sir W. Fergusson says, with respect to the flap operation, "If, in transfixing, the flaps be made purposely short, and then, retraction being made, the knife be carried round the exposed tissues which cover the bone, a cone will be formed resembling that in the ordinary circular operation, and thus by a combination, a compromise of the two methods (the circular and the flap), a covering to the end of the bone, in other words a stump, will be left, superior, in my estimation, to any other," "though," he adds, "that cutting from without inwards is in many instances followed by the best results" (Lect. on Prog. of Surg., 1867).

Utilising skin for flaps.

Besides these recognised forms of amputation, many others are performed, the Surgeon having too often "to cut the flap according to the tissues," particularly in cases of injury. He has to utilise what skin there is left uninjured in order to prevent the necessity of amputating higher up; it may be that one external or internal flap can be made, one anterior or posterior—in fact, any form or combination of flaps the Surgeon may be called upon to make to carry out the object he has in hand, viz. the removal of the part that must be removed and no more, with the least sacrifice of parts. Indeed, as already stated, under rare circumstances, an amputation may be best performed without flaps, or with poor ones, it being a safer, and, I believe, a sounder practice to take off a part that *must be* removed to save life, immediately above the seat of injury, even with bad, poor, or no flaps, than for the sake of making flaps that may slough, to amputate higher up, possibly with the sacrifice of a joint, and by so doing to incur an unnecessary danger to the life we are operating to save, Petit's fundamental rule being far from true, that "as little of the flesh should be cut away as possible, but the more the bone is removed the better" ('Traité des Malad. Chir.,' tom. iii, p. 250).

As a variety of the antero-posterior flaps the Surgeon may at times, by transfixion, make the posterior one first, and then taking between his fingers and thumb all the soft parts not included in the posterior flap, complete the operation either by passing the end of the knife beneath these tissues and cutting outwards, or by cutting from without inwards, as in the former case. This plan is most expeditious, and was one generally adopted by the late Mr. Morgan, of Guy's.

In some cases, two lateral flaps may be made by either transfixion or cutting from without inwards.

The Flap Operation.

The flap operation. The Surgeon having decided upon the operation, and obtained the consent of the patient or of his friends to its performance, should see, unless time presses, that any fæcal accumulation is removed by either a mild aperient or an enema administered thirty-six hours beforehand, and that as good a meal as the patient can take be given four or five hours before the time fixed for the operation. The meal should be of meat, where possible, with some stimulant, or, when solids are not acceptable, of a mixture of milk, egg, and brandy; for, assuming that chloroform or some anæsthetic is to be administered, it is essential, to guard against sickness, and to have the process of digestion fairly completed beforehand, since vomiting is more prone to take place with a full than an empty stomach. The part to be operated upon should be well washed previously, and, when much hair is present, also shaved before the patient is placed upon the operating table.

Preliminary treatment.

Instruments. All instruments and dressing appliances should be arranged out of the patient's sight before the time of the operation, and a sufficient number of assistants provided and special duties allotted to them.

First tray. Thus, on one tray there should be a tourniquet or elastic bandage to prevent hæmorrhage, and good torsion forceps to twist, or ligatures to tie the vessels; amputating knives of sufficient length and size, with a bistoury or catlin to divide the soft parts, and saw and bone forceps for the treatment of the bone; a tenaculum should likewise be at hand to take up vessels that have retracted; there should be also a pair of scissors, and a linen retractor. The torsion forceps I employ (Fig. 120) are as good for taking up an artery to tie as for twisting.

Second tray. On a second tray every appliance for the dressing of a stump should be arranged, such as suture needles armed with waxed silk, wire, or carbolised catgut; strapping cut into sufficient lengths and breadths; lint for pads or dressings, and splints when applicable; a can for hot water to heat the strapping should not be omitted; hot and cold water in abundance, *clean* sponges supplied by the Surgeon, well washed in iodine water and squeezed dry, and soft towels so arranged as to be always at the Surgeon's command during the operation, must be provided.

Assistants. With respect to assistants, one to give the anæsthetic is a necessity, and, when possible, he should be an expert to whom the Surgeon can resign his patient with confidence, as it is trying and somewhat risky for the operator when otherwise engaged to have an eye to the anæsthetist. A second is wanted to hold the limb above and to command the artery of the limb to be amputated; a third to hold the limb below till it is removed, and subsequently, to sponge and help to twist or tie the vessels; while a fourth is of essential service in amputation of the thigh and leg to hand the instruments, sponge, or to do what may be required, &c. They should be placed as shown in Fig. 609.

Their duties.

The nurse should be near to take away and clean all sponges as they are used, and to replace them with others, squeezed quite dry.

When the operation has to be performed by daylight the table should be placed where the best light can be obtained, and when by candle-light sufficient provision must be made. A good operating lamp is of great use, as well as a hand-glass to throw light upon any one part.

Operation table.

The operating table should be narrow and steady, a kitchen table with flaps being the best, and is always available. In hospitals, there ought always to be a special table.

In amputations of the upper extremity the patient should be brought well to the side of the table, and in amputations of the lower extremity well downwards, the opposite limb being secured by a turn of a bandage or strap to the leg of the table.

Surgeon's position.

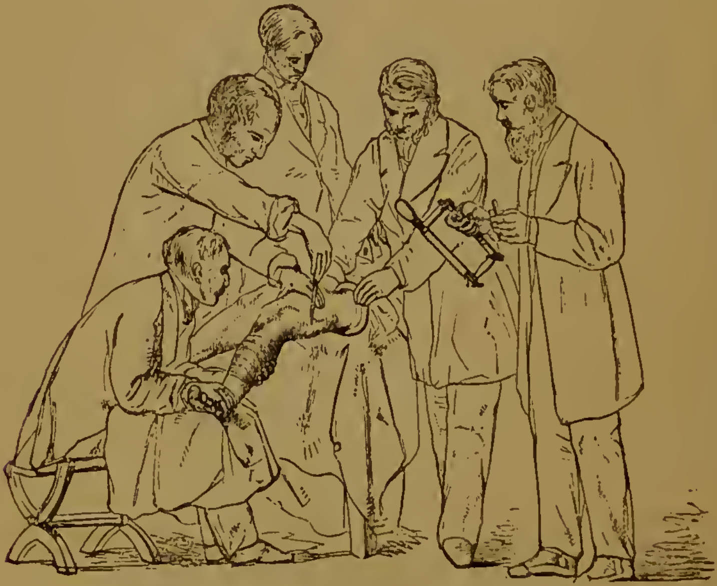
In amputating, the Surgeon should always stand on the *right-hand side* of the part to be amputated, in order to keep during the operation full control with his left hand of the flaps, and possibly, of the main arteries, and afterwards of the stump. He should, moreover, see that the tourniquet is so fixed as to control the vessel when tightened, which should on no account be done until the operation is about to be commenced. The limb to be amputated should be emptied of its venous blood before fixing the tourniquet, by raising its end for one or two minutes and smoothing the veins from below upwards by pressure with the band. The limb should then be constricted high up by a tourniquet, or, Esmarch's elastic bandage.

Tourniquet.

Elevation of limb.

In the flap operation now being considered (and for the sake of illustration I will suppose it to be a thigh) the Surgeon should mark out with his eye the point at which he proposes to divide the bone, and, with his thumb on one side of the limb, and fingers on the other, grasp it at a spot corresponding to the base of the anterior flap he is about to make, cutting from without inwards, taking care that the *base* of this flap is at least an inch lower down than the point at which the bone is to be divided. The anterior flap, which should be cut first and consist of skin, ought to be as long as the soft parts below will allow, and large

Fig. 609.



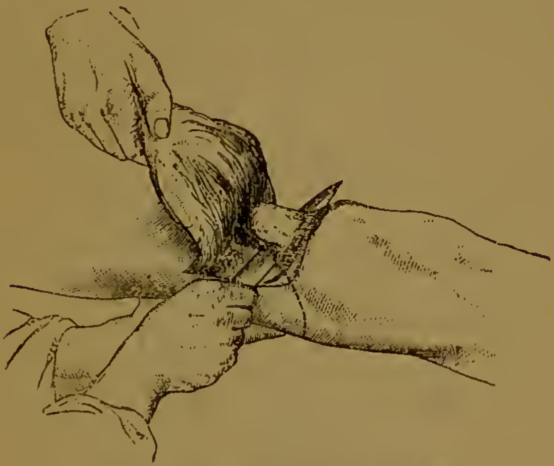
Surgeon and his assistants arranged for an amputation.

Formation of flap cutting from without.

enough to cover half the stump, or rather more than half the diameter of the limb, but when possible, it may be longer, since it is now generally admitted that the long anterior flap forms the best stump. The skin flap should be broad and cut square, with the angles rounded off, but not pointed. The muscles should then be divided down to the bone with a clean cut of the knife made from heel to point, and reflected with the skin flap. The anterior flap having thus been made, the point of the knife ought then to be passed through the wound beneath the bone, and the limb so transfixed as to include all the tissues that remained undivided. The knife should then be made to run downwards parallel to the bone, far enough to make a flap of the required length, and then turned backwards, the outward cut being made sharply (Fig. 610).

Flap should be broad.

FIG. 610.



Amputation of the thigh by flap operation.

The Surgeon during this stage of the operation should support with his left hand the under surface of the posterior flap. When the anterior flap has been only made of sufficient length to cover half the face of the stump, the posterior must be cut long to allow the two to meet. When the anterior flap has been a long one, two thirds of the length required to cover the stump, the posterior flap need only be half the length of the anterior. Long flaps always yield the most satisfactory results.

Aud long.

When the flaps have been made, they should be carefully held away from the bone, which is to be bared upwards for about an inch above their base where it is to be divided, and two periosteal flaps cut and pressed upwards. The soft parts ought to be carefully held away from the bone to escape injury, and for this purpose the linen retractor is of great value. The saw must then be applied, the bow saw (Fig. 609) being probably better than the flat. It should be used from heel to end with a firm, decided, free movement; too much pressure upon it being likely to cause splintering of the bone. During these steps of the operation, the assistant who holds the limb must be careful neither to elevate nor to depress it, for he will cause by the former act the Sur-

Section of bone.

Periosteal flaps.

geon's saw to become locked, and by the latter, splintering of the lower border of the bone. The best plan for the assistant to adopt is to apply extension to the limb in the axis of the bone to be divided, as if to draw the patient downwards, though not with sufficient force to effect this result.

Splintering of bone. When any splintering of the bone has taken place the rough margin ought to be carefully smoothed down with the cutting forceps, care being observed not to tear away the periosteum.

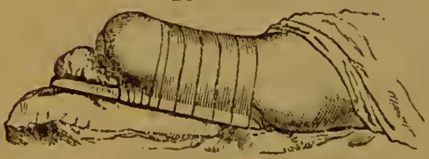
Periosteal flap. Dr. McGill, of the United States Army, has suggested the propriety of making the periosteal flaps, as described above, to cover in the end of the divided bone in amputation, and gives three cases in which this was done with excellent effect (Circ. No. 3). I have adopted the plan on many occasions with satisfactory results; in some cases the end of the divided femur being capped with a mass of new bone.

Securing the vessels. The bone being sawn through, the stump is to be raised and the main artery at once seized; the vessel should be drawn out of its sheath, firmly held with forceps (Fig. 120), and sharply twisted sufficiently often for the Surgeon to feel that resistance has gone. The end ought not to be twisted off. The smaller arteries should be treated **Torsion.** in the same way, it is possibly the best practice to twist off the ends of the small muscular and cutaneous branches.

Ligatures. When ligatures are preferred they may be used, the carbolised catgut probably being the best.

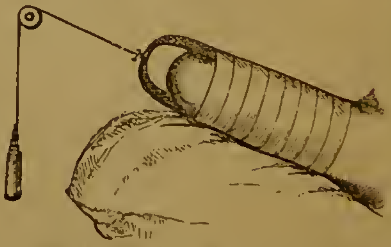
As soon as the chief vessels have been secured, the tourniquet should be taken away and the stump elevated to assist the venous circulation, the assistant being ready with his finger to compress the main artery of the limb if any vessel remain unsecured. Any nerve trunks that have been cut long in the flaps should be removed to a level with the bone. A stream of iodine water may then be made to pass over the end of the stump to cleanse it of all blood, and check capillary bleeding, and the surface should next be dried with a sponge squeezed dry out of hot iodine water, the Surgeon satisfying himself that the vessels are all safely secured. The edges of the flaps may then be adjusted and kept **Sutures.** in apposition by sutures, which must not be put in too closely, but inserted about half an inch from the margin of the wound, and made to perforate the skin and fat obliquely to the free border of the flap; the most dependent corner of the wound should be left open for the **Drainage.** introduction of a drainage-tube.

Fig. 611



Thigh stump, with splint.

Fig. 612.



Thigh stump with splint for extension.

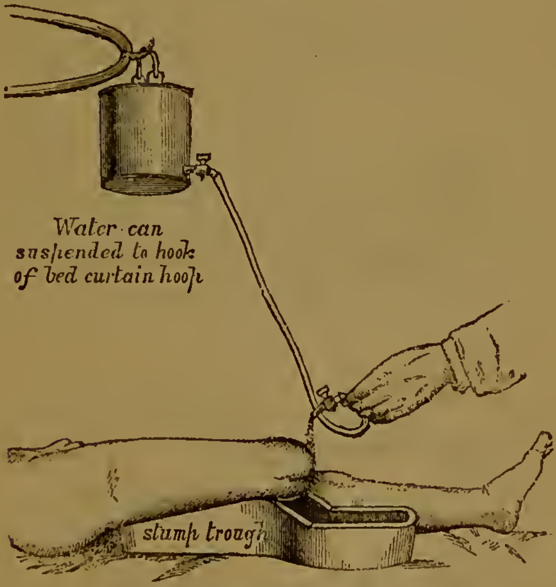
Splint. A posterior splint ought then to be fixed on the stump (Fig. 611), with pads of lint or sponge to maintain steady pressure upon the base of the flaps, though not on the wound, and a piece of iodoform or carbolic gauze, through which a hole has been cut for the end of the drainage-tube, is to be applied to the surface of the wound.

A square of Gamgee tissue should then be bound over the stump, or a good large sponge, either of these materials forming a firm elastic compress, which keeps the flaps well in apposition and checks bleeding, due care being taken to keep the end of the drainage-tube exposed. To seal a wound completely, and not to leave a drainage opening, must always be regarded as bad practice. With well-adjusted flaps, good drainage, and rest, as secured by the application of a splint, most stumps may be expected to do well.

Dressing stump.

The stump may be raised, as in Fig. 611, for the first day after the operation, but subsequently placed in a horizontal position. It should not be dressed for three or four days unless it becomes uncomfortable, or there is any evidence of retained secretion, for the less the parts are disturbed during the early days the better, repair going on much more satisfactorily when left alone than when the dressings are too frequently changed. To dress a stump, the trough, water-can, and tube, as illustrated in Fig. 613, are to be recommended.

Fig. 613.


Water-can suspended to hook of bed curtain hoop
stump trough

Trough and water-can for dressing stump.

Retraction of flaps.

When anything like retraction of the flaps exists, extension may be applied by means of a splint of perforated zinc, as seen in Fig. 612.

Before chloroform was introduced it was the late Mr. Aston Key's, as well as Mr. Syme's practice to leave the stump open for a few hours before its flaps were brought together, and doubtless the measure was good, for in that time every bleeding vessel showed itself, and the surface of the wound became glazed, and, therefore, in a state good for repair; but, since anæsthetics have been in use, this practice has fallen into desuetude. The application of the wet sponge, squeezed dry out of hot iodine lotion, renders, moreover, such a practice unnecessary.

Removal of sutures.

The stitches may be taken away on the third or fourth day, when the parts if they gape, or if union is not solid, should be supported by strapping. The wound may be dressed with the mixture of terebene, 1 part, and olive oil 3 parts, or iodoform gauze and Gamgee tissue.

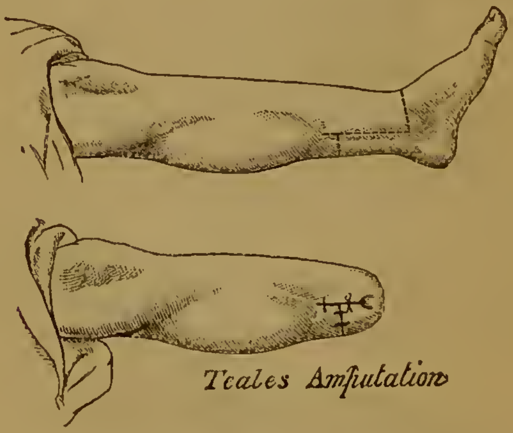
For the dressing of wounds the reader must refer to an early chapter.

Teale's Amputation, a Modification of the Skin and Muscular Flap.

Teale's amputation

This was introduced "to procure a more useful stump, and in the hope of somewhat diminishing the mortality of the operation. It is proposed to amputate by a long and a short rectangular flap, the long flap folding over the end of the bone being formed of parts generally devoid of large blood-vessels and nerves, whilst those important structures are contained in the short flap. The size of the long flap is determined by the circumference of the limb at the place of amputation, its length and its breadth being each equal to half the circumference. The long flap is, therefore, a perfect square, and is long enough to fall easily over the end of the bone. In selecting the structures for its formation, such parts must be taken as do not contain the larger blood-vessels and nerves. A flap so formed will be, for the most part, anterior in position, as far as regards the general aspect of the body, but superior when the patient is in the recumbent position, as during the after-treatment. The short flap, containing the chief vessels and nerves, is, in length, one fourth of the other (Fig. 614). The flaps being formed, the bone sawn, and the arteries tied or twisted, the long flap is folded over the end of the bone, and each of its free angles fixed by suture to the corresponding free angle of the short flap. One or two more sutures may be required to complete the transverse line of union of the flaps, and to unite the side of the short to the corresponding portion of the long, as well as the reflected portions of the long flap to its unreflected. Thus the transverse line of union is bounded at each end by a short lateral line at right angles to it."

Fig. 614.



Caution in making flaps

The Surgeon should be careful in making this long anterior flap not to scarify it with his knife, more particularly when it is chiefly skin, as in the leg, since, on account of its length, it is very prone to slough, and if scarified this tendency is increased; indeed, this sloughing of the long flap is the great disadvantage of the operation, for in an ordinary thigh, twelve inches in circumference, a flap of six inches would have to be made. To secure a cicatrix away from the extremity of a stump is a point of great practical value, and to do so by a long anterior flap is, doubtless, an advantage; but this often requires more soft parts than are generally at the Surgeon's disposal, unless more of the limb be taken away than requires removal. This object may, however, sometimes be secured by making a shorter anterior flap than Teale suggests, and dividing the bone one or two inches above the line of the skin flaps. In fact, as long as the anterior flap, whether rectangular or oval, is of sufficient length to be drawn over the end of the stump to its posterior aspect, the principle of Teale's operation is observed.

Mr. Spence, in his 'Surgery,' 1871, p. 749, tells us that he acted much upon this principle in 1858, making one long *anterior skin and muscular flap,* with a short, posterior, clearing the bone for nearly two inches before dividing it.

The Mixed Form of Amputation.

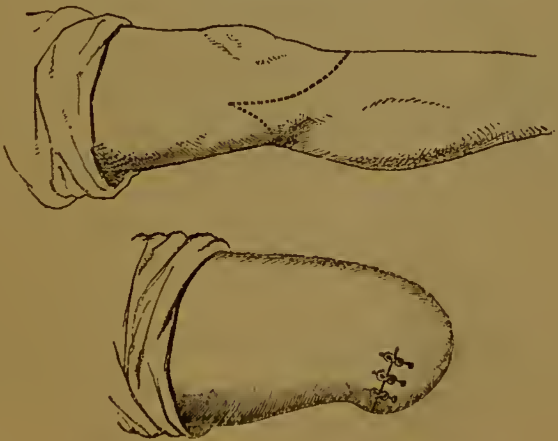
Mixed form of amputation.

The mixed form of amputation, as illustrated by Carden's operation will now claim attention. In principle, it includes a combination of the circular and flap, already described.

Carden's description.

"The operation consists in reflecting a rounded or semi-oval flap of skin and fat from the front of the joint (knee), dividing everything else straight down to the bone, and sawing the bone slightly above the plane of the muscles, thus forming a flat-faced stump with a bonnet of integument to fall over it. The operation is simple. The operator, standing on the *right* side of the limb, seizes it between his left forefinger and thumb at the spot selected for the base of the flap, and enters the point of the knife close to his finger, bringing it round through

FIG. 615.



Carden's amputation, with long posterior flap.

skin and fat below the patella to the spot pressed by his thumb, then turning the edge downwards at a right angle with the line of the limb, he passes it through to the spot where it first entered, cutting outwards through everything behind the bone. The flap is then reflected, and the remainder of the soft parts divided straight down to the bone; the muscles are then slightly cleared upwards, and the saw is applied. Or, the limb being held as before, the hand and knife may be brought round under the limb, as in the circular operation, and the blade entered near the thumb and drawn round to the opposite side, when the ham may be cut across by turning the edge of the knife upwards, and the operation completed as before. In amputating through the condyles the patella is drawn down by flexing the knee to a right angle before dividing the soft parts in front of the bone; or, if that be inconvenient, the patella may be reflected downwards" ('Brit. Med. Journal,' April, 1864).

Its principle.

This operation of Mr. Carden's is very valuable, not only as applicable to the knee-joint to which it was originally applied, but on account of the principle of practice it embodies, that of making skin flaps and the circular division of the muscles. The practice, however, was not new, for when Mr. Carden began it in 1846, Mr. Syme had published, in the 'Edin. Month. Journ. of Med. Science' of the same year, his modification of the circular method of amputation in the lower third of the thigh, by making two semilunar skin lateral flaps and oblique section of the muscles down to the bone, dissecting the skin flaps an inch or more upwards, and cutting the muscles on a level with the retracted skin. Liston also, in 1839, preferred skin flaps alone in muscular subjects.

Accepting it as an operation for the removal of a limb through the condyles of the femur, I have, however, found it advisable to make a slightly longer posterior flap than Carden advises (*vide* fig. 615), making it only of skin, and taking care to make the long anterior flap broad, with a base corresponding to the posterior border of the lateral surfaces of the condyles.

Its advantages.

In this operation there is but a slight section of the muscular tissue, and beyond the popliteal artery few vessels of importance are divided. The stump that remains is likewise remarkably good, being long and broad, upon which patients can bear their weight without pain. This operation is, I believe, applicable to a far larger number of cases than is generally thought, and, with Lister, I look upon it as a great advance in surgery. It is, moreover, far safer than amputation through the shaft of the femur.

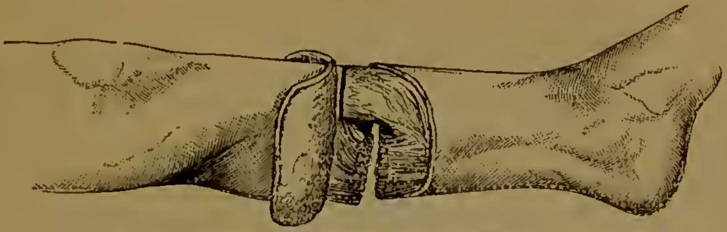
Object of long anterior skin flaps.

The object sought in all these long anterior flap operations is to procure a cicatrix that is placed behind the stump out of harm's way, and so long as this end can be secured without sacrificing more of the body than is absolutely required by the exigencies of the case the amputation is good; and it is a matter of small importance whether the rectangular and muscular flaps of Teale, the convex skin flaps of Carden, or the skin and muscle as practised by Spence, be employed. I prefer Carden's flap with the modifications described, to any other, and when applied to the knee, where it is most applicable, regard it with high favour.

General applicability of Carden's method to all amputations.

This "mixed method of amputation" has, however, a wider application than to operations about the knee; and, I believe it to be by far the best operation in all amputations of the leg and forearm. It combines the advantages of the circular and the flap without the disadvantages; and rarely, if ever, calls for the sacrifice of more of the extremity than is absolutely required. In its performance the two lateral skin flaps should be made sufficiently long to meet over the stump without stretching, the Surgeon judging by his eye their required length, while the muscles should be divided by a circular sweep an inch below the base of the retracted flaps, the bones being bared to this extent before they are divided (Fig. 616). Mr. Cock includes the muscles in the flap, but I hardly think this necessary unless the skin is very thin. When the flaps are brought together a pretty stump is seen, and subsequently it turns out to be a very good one (Fig. 617).

Fig. 616.

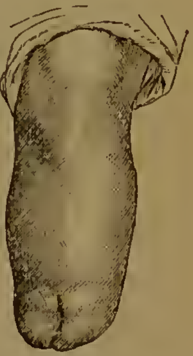


Amputation of the leg by the mixed method.

In amputation of the forearm, the mixed form is *the* operation, the skin flaps being made from the anterior and posterior aspects of the limb, the flap amputation executed by transfixion, being very unsatisfactory, on account of the tendons of the forearm (Fig. 622).

In amputation at the wrist and elbow-joints nothing can be better than this mixed method (Figs. 620-1), the Surgeon having it in his power, according to circumstances, to make one long anterior, posterior, or lateral flap cover the stump, and thus to secure the cicatrix being out of harm's way. One of the best stumps of this kind I ever obtained was at the elbow-joint, in which I made a long skin posterior flap, the cicatrix subsequently being placed above the condyles of the bone and in front (Fig. 621).

Fig. 617.



Stump after an amputation of the leg by the mixed method.

SPECIAL AMPUTATIONS.

Amputation at the shoulder-joint.

The subject of amputations as a whole having been considered, I propose now to describe them in detail as applicable to different parts of the body, and begin with the upper extremity.

Amputations at the Shoulder-joint.

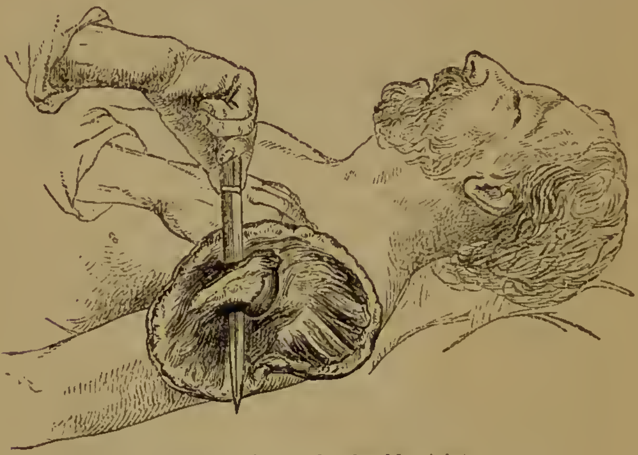
This operation may be called for in cases of injury, when the arm has been so irreparably injured as to render amputation through the tuberosities impossible or excision inapplicable; or for disease, when too extensive to be taken away by a less severe measure; the Surgeon always bearing in mind that large portions of the humerus may be resected with advantage so long as the chief vessels and nerves of the arm are intact, and that amputation through the humerus, however high, leaves a far better stump than at the joint.

After this operation, when performed for injury, one out of three cases die; but when for disease, one in two.

Double flap operation.

The operation is best performed by means of the double flap operation. A good assistant is required to compress the subclavian artery above the clavicle, or to take charge of the axillary in the lower flap. When the right arm has to be amputated the Surgeon should stand behind, and when the left in front of his patient (Fig. 618); under both circumstances a deltoid flap should be first made, cutting from without inwards between the posterior part of the axilla and an inch in front of the acromion process, this incision including in its sweep the whole deltoid muscle. Having reflected this flap with a few bold sweeps of the knife, the head of the humerus should be disarticulated, the knife being kept close to the bone, and the lower flap made, three or four inches long, by cutting from within outwards. If this part of the operation is done with care, the main artery of the limb will only be divided on the completion of the second flap, when the Surgeon with his left hand can secure it between his finger and thumb until it can be either twisted or tied.

Fig. 618.



Amputation at the shoulder-joint.

During the first step of this amputation, the arm should be held well out by an assistant, but during the second, at first, near the body, and when the knife has passed beneath the head of the bone it should be abducted. A very good stump usually follows this operation. At no joint of the body, however, is the Surgeon more compelled to form his flaps according to the circumstances of the case than at the shoulder, since the majority of cases of amputation at this part are for injury, where the arm has been wholly or partially torn off, when the Surgeon must make the best flap he can, and at times no flap at all. As good a stump as any I have made at this joint was one in which a piece of integument from the posterior part of the arm was alone available. I have seen many cases in which the flaps sloughed, and yet good cicatrices followed, the soft parts being readily drawn forward by the cicatricial process.

Anterior and posterior flap.

Some Surgeons in this amputation prefer making an anterior and posterior flap, by perforating in front of the posterior axillary fold to make the posterior flap, disarticulating and dividing the axillary artery in the anterior flap; but the operation, although good, is not so efficient as the former.

Amputation at the Arm.

Amputation at the arm.

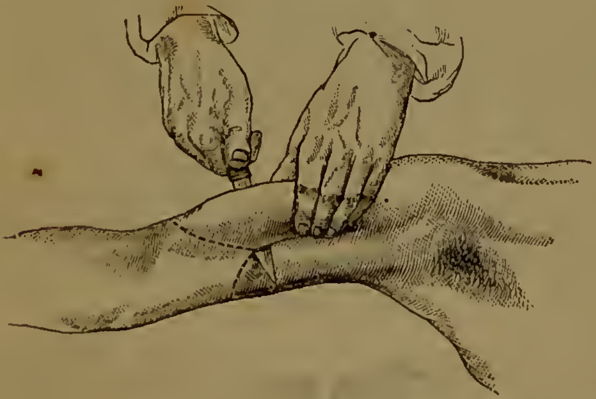
Excision of the elbow-joint, even when three or four inches of the humerus are taken away, is such a very successful operation that amputation at the arm is never called for when excision can be entertained, and this observation applies as forcibly to cases of injury of the elbow-joint, as seen in civil and military practice, as it does to cases of disease.

Statistics.

When, however, the forearm and elbow-joint are hopelessly injured, gangrenous, or diseased, amputation may be demanded, and, therefore, as the very worst cases are included in this category, the mortality of the operation is great, viz. one in three for injuries, and one in ten for disease.

The flap operation, as already described, is the best in this region, the anterior flap being made by cutting from without inwards, towards the bone, excluding the brachial artery, and the posterior by transfixing all that remains. In a very large muscular arm, the skin flap and circular cut through muscle, *i. e.* the *mixed* operation, may be performed. Amputating by double flaps and transfixion is, however, excellent (Fig. 619).

FIG. 619.



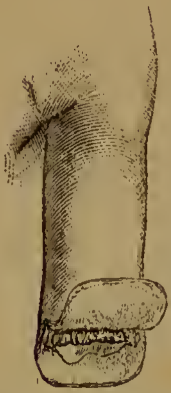
Amputation of arm by flap operation.

Amputation at the Elbow-joint

Amputation at the elbow.

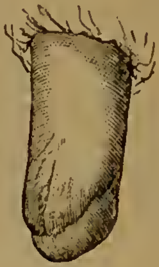
is a capital operation, and ought always to be performed in preference to any higher operation, when amputation above the forearm is imperative, if the condition of the soft parts will allow. By this operation an excellent stump is obtained, and, as in other amputations at joints, less constitutional disturbance, and probably less risk to life is incurred than after amputation through the bones. I have had a patient up and

Fig. 620.



Amputation at elbow-joint by mixed method.

Fig. 621.



Stump after amputation at elbow-joint.

about on the seventh day after such an operation, the wound having united without any traumatic fever or other disturbance.

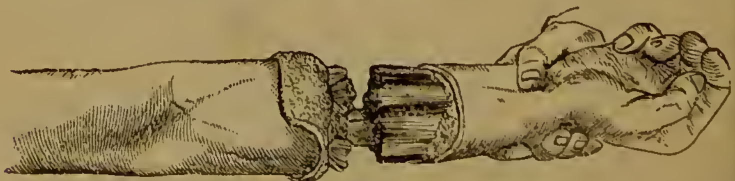
It should be performed by the mixed method of amputating, by anterior and posterior skin semi-circular flaps, beginning and ending at the lower extremities of the condyloid ridges, the muscles being divided transversely on completing the disarticulation (Fig. 620). In the drawing of the stump (Fig. 621) the posterior flap was made longer than the anterior, in order that the cicatrix might be out of harm's way. I have performed this operation on six occasions, and the result in all was so good that I cannot too strongly advocate it whenever the injury or disease will allow; in fact, it ought to be performed whenever enough integument can be saved to cover the bone, and the disease or injury for which amputation is called for has not attacked the humerus.

Amputation at the Forearm.

Amputation through the forearm.

This is comparatively a rare operation, modern Surgeons doing their utmost to save the hand. It is consequently only performed when the hand is hopelessly crushed, or so extensively diseased as to forbid

Fig. 622.



Amputation of forearm by mixed method.

any other treatment being entertained. At Guy's hospital it was performed only eighty-four times in thirty years ending 1874—on forty-four occasions for injury, nine patients dying, or one in five; and on forty occasions for disease with five deaths, or one case in eight, the operation being performed in the very worst cases. Amputation of the forearm ought always to be performed by the mixed method; the one by transfixing being very unsatisfactory, the many tendons, &c., of the part causing ragged flaps, and thus favouring suppuration. Two well-cut and fairly long semi-circular skin flaps and a clean circular section of the muscles are preferable to the flap operation, and yield a good stump (Fig. 622). The skin is usually too thin for one long skin flap, and there are too many tendons for a Teale's.

Amputation at the Wrist-joint.

At wrist-joint.

I have never performed this operation, nor seen it done; but I have seen two cases in which it had been performed years before for injury, and in both, the stumps were constant sources of trouble to their owners during the winter months, from their being the seat of chilblains and ulcerations, on account of the feebleness of the circulation through the thin cutaneous covering, and in neither could a good hand be fitted with comfort. Both patients likewise regretted that the amputation had not been performed higher up.

Under these circumstances I am disposed to follow the opinion of my patients, and cannot advocate the operation. If, however, it be called for, it should be performed with skin flaps and the circular division of the deeper tissues, or by the pure circular operation.

Amputation of the Thumb and Fingers.

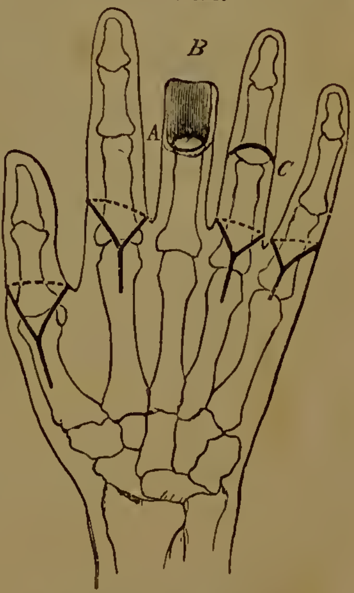
Amputation of thumb and fingers.

A knowledge of the shape of the articular ends of the bones and the position of the different articulations of the hand is of importance in all operations on these parts, and I have, therefore, supplied a figure to illustrate these points as much as possible (Fig. 623).

Anatomical details.

The Surgeon should remember that, with the hand closed the knuckles are formed by the heads of the metacarpal bones, the bases of the phalanges being in front, and that in the second and third rows the same arrangement holds good. To open any of these joints, consequently, the line of incision should be anterior to the knuckles on the dorsal aspect and in the fold of the fingers on the palmar. In the figure it will be observed, also, that the two distal joints are concave, with the concavity looking towards the ends of the fingers, while at the metacarpal joints the concavity points the other way, the heads of the metacarpal bones being round; from the palmar surface the metacarpo-phalangeal

Fig. 623.



Outline diagram for amputation of the thumb and fingers.

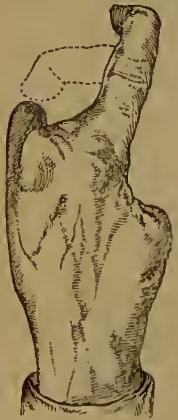
joints are more than half an inch behind the clefts of the fingers, corresponding pretty nearly with the palmar furrow of the hand, this furrow likewise corresponds with the upper limit of the synovial sheaths of the flexor tendons, and with the bifurcation of the digital arteries.

In amputating at the phalangeal joints (Fig. 623, C) or through the bones, anterior and posterior semicircular flaps are better than one long flap, although this may at times be performed with advantage, one long anterior flap (B), after opening the joint from its dorsal aspect (A), being the most common shape; but the Surgeon must in these cases be much guided by what skin he has to utilise. As a rule it is wise *not* to take off the head of the proximal bone, though when there is not sufficient flap to cover it the Surgeon may be justified in removing its head with bone forceps.

Amputation of fingers at metacarpal joint.

Amputation of the fingers at their metacarpal joints requires much nicety, and in all the fingers the Surgeon should remember that he is on no account, unless absolutely required, to interfere with the palm of the hand; his incision in the palmar surface must never go beyond the fold of the joint. In performing this operation the Surgeon is to take charge of the amputated member, an assistant holding the hand, separating the fingers, and compressing the radial and ulnar vessels. With the hand pronated, a vertical incision should be made about one inch long with a strong scalpel over the dorsal aspect of the head of the metacarpal bone, and from its distal end over the joint the knife should be made to pass up one cleft of the finger close to the bone to be removed, round the palmar surface of the finger in the fold, and through the second cleft to the point from which the circular incision started, the tendons and ligaments being divided as cleanly as possible (Fig. 623). The joint can then be opened and the finger removed. In a labouring man, it is wise *not* to remove the head of the metacarpal bone unless diseased, although in the higher classes it is sometimes expedient to take it away with bone forceps, to allow the neighbouring fingers to be brought closer together, and thereby to improve the aspect of the hand. With the same object it is at times wise to take off the head of the metacarpal bone of the little or index finger obliquely, *i. e.* in a direction sloping upwards away from the median line of the hand. In amputating either the little or index finger at this joint, the same form of incision may be made, the outer flap under both circumstances being somewhat larger than the inner, in order that the cicatrix may be placed close to the adjoining finger, and thus out of all harm's way. If the incision be made so as to allow the scar to fall over the exposed aspect of the hand, the result is very inconvenient, and often painful, as the hand naturally rests on its outer borders.

Fig. 624.



Hand after amputation of part of thumb, index and two outer fingers.

Amputation of thumb.

The same arguments apply to the *amputation of the thumb*, one long external skin flap adjusted to a shorter flap in the cleft being far superior to the palmar and dorsal flaps usually adopted. But it may be here stated, that amputation of the thumb ought to be a very rare operation, as it is far better practice in all cases of injury to the thumb, where there is no possibility of saving it, simply to cut off any sharp point of bone, trim up the soft parts, and allow the stump to granulate, than to make what is sometimes called a good job of it by amputating the organ higher up; for any stump of a thumb, however short or ugly, is of use. In the hand here figured (Fig. 624) the man was an engineer, and he has been able for years to follow his occupation with but little inconvenience.

Ought to be very rare.

To describe other amputations of different parts of the hand is unnecessary. As little as possible should be taken away, and this by making skin flaps only, care being always observed to divide the tendons by a clean cut, and as high up as possible. The ingenuity of the Surgeon and the wants of the individual case will suggest the best means by which the latter can be supplied.

Amputations of the Lower Extremity.

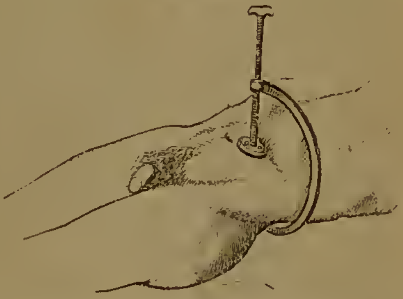
Amputation of the lower extremity.

These are of more importance than those of the upper, from their greater severity. They are, moreover, larger operations, more dangerous, and possibly more difficult.

At the hip-joint.

Amputation of the thigh at the hip-joint is a formidable operation, and is only justifiable under desperate conditions, when a limb is irreparably crushed or diseased, and resection of the head of the femur with more or less of its shaft is out of question. When performed for accident it is almost always fatal, not 10 per cent. recovering; for disease, however, it is more successful, the risk being about equal, although after resection of the head of the femur which has failed it is somewhat better. The best flaps where F. Jordan's method cannot be carried out appear to be the external and internal. The patient being brought to the edge of the table, with the tuberosities of the ischium in view, and hæmorrhage controlled by Jordan Lloyd's method (p. 633), or Lister's tourniquet (Fig. 625). The Surgeon should then make the external skin flap by means of a semicircular incision, starting from the tuberosity of the ischium downwards and outwards one hand's breadth below the great trochanter, and then upwards and forwards to the centre of the groin (on the outer side of the femoral vessels). This flap should then be reflected upwards so as to expose the trochanter, and allow the joint to be opened, and disarticulation to be completed; the limb being forcibly adducted by an assistant to facilitate this step. In doing this, no vessels of any importance are divided, while the most difficult part of the operation is performed.

Fig. 625.



Lister's abdominal tourniquet.

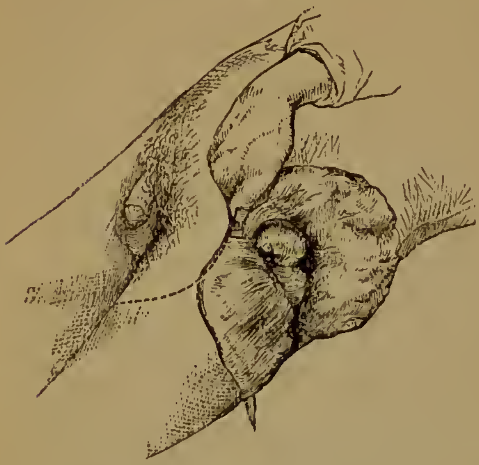
Author's method by external flap.

Internal.

The inner flap now remains to be made, which is readily done by transfixing the thigh on the inner side, inserting the knife (twelve inches long) in the anterior wound, passing backwards close to the inner side of the neck of the femur, and bringing it out near the tuberosity of the ischium where the external incision was commenced, and then cutting out through the soft parts, including the adductors, &c. (Fig. 626). In doing this, all the pelvic muscles are separated from the thigh-bone at one clean sweep, and a few touches of the knife complete the amputation. Should there be much cause to fear loss of blood the common femoral artery may be ligatured in the wound before the second flap is made, or, it may be divided and twisted. The vessels can then be secured in the way the Surgeon proposes, and the parts brought together, the two flaps usually forming an excellent covering to the acetabulum. The wound being an antero-posterior one, and therefore good for drainage, a good scar results.

Previous ligation of artery.

FIG. 626.



Amputation at hip-joint by external and internal flaps.

Usual mode.

This operation I believe to be better than the anterior and posterior flap usually advised, and which is thus described by Erichsen:—" If the operation be on the left side, the knife (twelve inches long) should be entered about two fingers' breadth below the anterior spine of the ilium, and carried deeply in the limb behind the vessels directly across the joint, its point being made to issue just above the tuberosity of the ischium. In transfixing on this side care must be taken not to wound the scrotum or the opposite thigh; the back of the knife must run parellel to, but not against, the pelvis, and the point must not be held too high, lest it enter the obturator foramen. The anterior flap must then be rapidly cut downwards and forwards about five inches in length. The limb must now be forcibly abducted and everted, the capsule of the joint opened. So soon as this is done, the head of the femur must be pushed up by forcibly depressing and abducting the limb, so that it may start out of the acetabulum; the heel of the knife is then passed behind it, the remainder of the capsule cut across, and the posterior flap rapidly fashioned by carrying the knife downwards and backwards through the thick muscles in this situation; the posterior flap may be about four inches long." The operation is then to be completed as the former. In both these operations good assistants are needed to compress the bleeding vessels as they are divided, for hæmorrhage and the shock of the operation are the great evils to be feared. Lister's compressor, however, has rendered this serious operation safer than it was.

Good assistants needed.

Furneaux Jordan's Method.

Furneaux Jordan's operation, 'Surgical Inquiries,' 1880.

This excellent Surgeon, of Birmingham has described a method of amputation at the hip-joint which must be regarded as a far better operation than any that have been hitherto described, and it seems to be generally applicable, excluding only cases of new growth, in which the soft parts around the bone are involved in the disease. It consists in an incision along the outer side of the thigh, extending downwards from the top of the trochanter for six or more inches, the enucleation of the head of the femur from the acetabulum and the separation of part of the shaft from its muscular attachments, and finally a circular division of the soft parts down to the bone at any line thought desirable. The Surgeon may, if he choose, make the circular sweep through the soft parts before the shaft of the bone is turned out.

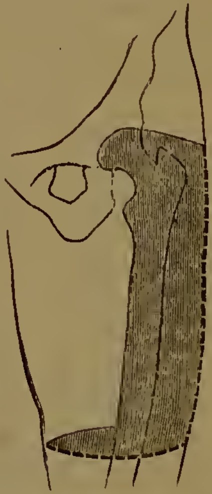
'Clin. Soc. Trans.,' 1883.

The periosteum should be saved from the shaft of the femur, if possible, and the attachments of the muscles thus saved, when, as shown by Mr. Shuter's case, a firm and movable stump may be obtained to fit into the bucket of an artificial limb and assist progression.

It is better, says its author, to enucleate the femur where it is most thinly covered, and cut across the limb where it is smaller and further removed from the trunk; it is better, moreover, not to touch the bulky soft parts at the inner and upper parts of the thigh.

In this I quite concur, and from what I have seen of this operation—and at least five have been performed at Guy's—I cordially recommend its adoption, and more particularly with the improvement as made by Shuter, in preserving the periosteum as much as possible.

FIG. 626A.



Furneaux Jordan's method of amputation at the hip-joint.

Jordan Lloyd's method of controlling hæmorrhage

Mr. Jordan Lloyd, also of Birmingham, has suggested an excellent method of controlling hæmorrhage in amputation at the hip-joint, which deserves a notice. I have seen it employed with marked success. It is to be applied as follows:—The limb to be amputated, having been emptied of its blood by elevation and friction towards the trunk, "a strip of black india-rubber bandage, about two yards long, is to be doubled, and passed between the thighs, its centre lying *between the tuber ischii of the side to be operated on and the anus.* A common calico thigh roller must next be laid lengthways over the external iliac artery. The ends of the rubber are now to be firmly and steadily drawn in a direction upwards and outwards, one in front and one behind, to a point above the centre of the iliac crest of the same side. They must be pulled tight enough to check pulsation in the femoral artery. The front part of the band passing across the compress occludes the external iliac, and runs parallel to and above Poupart's ligament. The back half of the band runs across the great sacro-sciatic notch, and by compressing the vessels passing through it, prevents bleeding from the branches of the internal iliac artery. The ends of the bandage thus tightened must be held by the hand of an assistant placed just above the centre of the iliac crest, the back of the hand being against the patient's body. To prevent the bandage slipping it should be fastened by a safety-pin to the roller" ('Lancet,' May 26, 1883).

Amputation at the Thigh.

Its mortality.

Primary amputations of the thigh, taken as a whole, are very serious, and, calculating cases at all ages, more than half die. In subjects under twenty years of age, however, better results can be recorded, the mortality being about half this amount; whilst in those over forty, the average is worse, age having here, as elsewhere, a striking influence on results. Primary amputations, however, in the upper third of the thigh are more fatal than those in the middle; and these again are more fatal than amputations above the knee, amputations through the condyles or at the knee-joint being better than all. The nearer the operation approaches the body the greater is the risk. Still, even in the worst cases of compound fracture of the thigh, when death seems inevitable, the Surgeon should operate, when, by so doing, any reasonable hope of saving life can be entertained.

In amputations for diseases a better account can be given.

Statistics.

In amputation of the thigh for *chronic joint disease* at all ages, the mortality is about 1 in 4, but under the age of twenty, 1 in 17; while over that period it is 1 in 3, the difference in the mortality of the operation at the two periods being very great. Thus, taking all cases of chronic disease together, out of 89 of my own, 13 died; of 99 of Callender's, 28; of 54 of MacCormac's ('Dublin Journal,' 1868), 10; and of 106 of Holmes's, 30; making a total of 348 cases, of which 81 died, or 1 in 4. In subjects under twenty years of age, out of 69 cases of Callender's and my own, four died, or 1 in 17; and of 119 cases over twenty years of age, 38 died, or 1 in 3; amputation of the thigh for chronic joint disease being nearly six times more successful in early than in middle life.

Effects of age on mortality.

Amputation of the thigh.

This operation in the upper or middle third, when the muscles are thick, is best performed by means of anterior and posterior skin flaps and the circular division of the muscle, or by the flap operation as illustrated in Fig. 610, the anterior flap being made by cutting from without inwards, and the posterior by perforating. The operation by lateral flaps, whether made of skin or muscle, or skin alone and circular muscle is not satisfactory, the bones having a tendency to appear at the upper angles between the flaps. In amputation at the lower third one long anterior flap may be made, and a short posterior, as previously described under Carden's operation (Fig. 615).

Supra-condyloid amputation.

Mr. W. Stokes, of Dublin, advocates ('Med.-Chir. Trans.,' 1870, 'Dublin Journ. of Med. Sci.,' 1875) the *supra-condyloid amputation* of the thigh, in which the femur is divided at least half an inch *above* the antero-superior edge of the condyloid cartilage, and the patella deprived of its cartilaginous surface is applied to the same surface, and fixed there with carbolised catgut sutures. The anterior skin flap is made oval, and the posterior fully one third of the length of the anterior.

I have performed this operation in one case with a good result, and have seen it performed on several previous occasions by my colleagues with success. I think well of it, and would suggest its wider trial. My colleague, Mr. Jacobson, has written an interesting paper on it ('Guy's Hosp. Reps.,' 1878).

This operation differs from what is known as Gritti's in the section of the femur, being about one inch higher up. Gritti's.

Amputation at the Knee-joint.

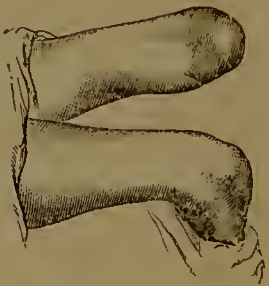
This is an excellent operation in all ways, and one that should always be performed in preference to any higher amputation when the special circumstances of the case will allow. It is apparently attended with less risk to life than when a section of the bone is made, and yields an excellent and serviceable stump, on which the weight of the body can generally be sustained. Velpeau revived the operation in 1830, while Mr. Pollock re-called the attention of London Surgeons to the subject ('Med.-Chir. Trans.,' 1870). In his paper he states that, up to 1870, 48 cases of the kind had taken place in England, and that 12 died, or one fourth; but since then the operation has been more common.

Statistics. I have now performed it upwards of twenty-three times. On 7 occasions for compound fracture of the leg, 6 of which recovered; in 13 cases for chronic disease of the knee-joint or leg, 11 of which recovered; and in 3 cases for gangrene of the leg from arterial obstruction, one of which alone recovered, the operation in the other two having failed to save life.

In only two or three of the cases did I remove the patella. In all the successful cases, excellent stumps were obtained (Fig. 627).

Operation. In performing this operation, a long, broad, anterior flap should be made, which must of necessity be of skin, and also a tolerably long posterior, for it is remarkable to what an extent the posterior flap always retracts. I prefer to make my posterior flap about two thirds the length of the anterior, and of skin only, and to divide the muscles and deeper structures by cutting from behind forwards about an inch below the joint end of the tibia, and not after disarticulation; the popliteal artery being thus divided low down, where it is readily secured. The patella should not be removed except when diseased.

FIG. 627.

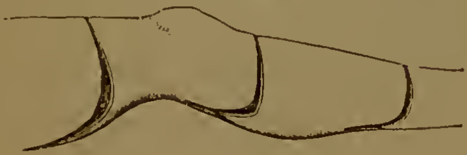


Stump after amputation at the left knee-joint.

When the operation has been completed, and the articular surface of the femur is found not to be healthy, or reparable, or the flaps too short, the condyles should be taken away, a thin rounded section of bone being removed, or more if the necessities of the case demand.

After the operation a troublesome suppuration occasionally takes place in the synovial bursa beneath the extensor muscles of the thigh, and when it occurs it should be dealt with by free incisions.

FIG 628.

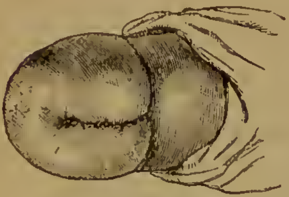


Stephen Smith's method of amputating.

Stephen Smith's hooded flap.

Stephen Smith, of New York, has suggested ('Amer. Journ. of Med. Sc.,' Jan., 1870) the formation of two lateral skin flaps for this amputation, each flap to be formed by an incision commencing one inch below the tubercle of the tibia, and carried downwards and forwards over the side of the leg (*vide* Fig. 628), until it reaches the under surface, when it is curved towards the median line. I have adopted this method on ten occasions with excellent results, and am disposed to think it the best. The stump left is very good, the cicatrix being vertical, and placed well behind the lower end of the femur (Fig. 629).

Fig. 629.



Posterior aspect of stump after S. Smith's amputation at knee-joint, showing cicatrix.

Amputation at the Leg.

Fatality.

Amputation of the leg for disease is a very successful operation, only about one case in twelve proving fatal. In young life it is more successful than at a later period.

Amputations for injury are, however, very unsuccessful, at least 60 per cent., or more than half the cases, dying. Pyæmia is a more common cause of death after this form of amputation than even after amputation of the thigh, it being fairly proved that the larger the section of the shaft of a bone the greater the liability to blood-poisoning.

Amputations of expediency in the leg are as dangerous as those for injury.

Amputation of leg.

This operation in the upper two thirds is, doubtless, best performed by the mixed method, by two skin lateral flaps and the circular division of the muscles, as already described (Fig. 616). When the condition of the soft parts forbids such an operation, other flaps may be made, any form being allowable to avoid sacrificing more of the limb than is necessary. In the lower third of the leg Teale's amputation is good, the long anterior flap not being too long, or so liable to slough. The long muscular flaps, and more particularly the posterior calf flap, cannot be recommended. In the lateral flap operation, Mr. Cock, who always includes the muscles and makes the flaps long, turns out excellent stumps. Some Surgeons, in this mixed method, make anterior and posterior skin flaps, but they possess no advantage over the lateral; while the anterior flap, falling over the edge of the tibia, is apt to slough or to form unpleasant adhesions. In dividing the tibia, its anterior edge should be rounded off with the saw.

Amputations of the Foot.

Amputation of the foot.

Principle to be followed.

In no part of the body has an improvement in surgery shown to greater advantage than in the foot, for in none has so much been done in the way of conservatism. Whereas formerly amputation of the whole foot was common, we have now Hey, Chopart, Syme, Pirogoff, the subastragaloid, and Hancock's operations, all based upon the well-established position that governs, or *ought to govern*, all amputations, viz. that no more of the body should be removed than the necessities of the individual case require, or, in other words, upon the principle of "the least sacrifice of parts." To amputate a foot where anything less would suffice, in the present age, is regarded as almost criminal, and Surgeons generally accept Hancock's well-put question, in his valuable lectures at the College in 1866: "Can anything be more unphilosophical than to advocate the sacrifice of any bone or joint of the foot for no other reason than that a particular operation should be performed?" ('Lancet,' 1866). Indeed, this principle of practice should be uppermost in the mind of every Surgeon called upon to treat any local disease, and in the hand and foot it should be so pre-eminently. Accepting this teaching Hancock's three other dicta necessarily follow:

Hancock's views.

That we should perform our operation as close to the diseased or damaged structure, and preserve as much of the foot as we possibly can do with safety to our patient.

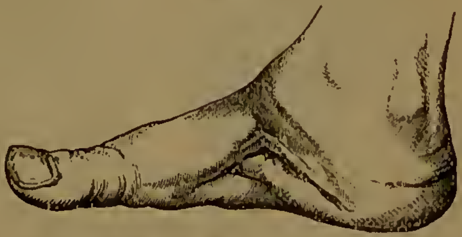
That, where practicable, we should cut through the tarsal bones with a saw in preference to disarticulating them.

That we should avoid the destruction of parts whenever we can do so.

These views of Hancock accord so closely with those I have attempted to lay down as guides to the Surgeon in the surgery of other parts of the body, that I have given them in his own words, and placed them as leading principles of practice to be observed in the surgery of the foot. I believe them to be of great practical value, and desire that the student should have them always before him in the treatment of every case of local injury or disease. The principle embodied in "*the least possible sacrifice of parts*" is one upon which most of the operations of the foot should be undertaken; and it is well to remember, that of the different amputations that have been recommended, while none of them are called for until minor measures have altogether failed, each succeeding one is only a degree more severe than the preceding. The Surgeon in the present day takes away diseased bone or bones without fear, and leaves nature to repair the breach with every confidence. I have taken away, in one case, the whole second row of tarsal bones, and in another, the three cuneiform, scaphoid, and cuboid with excellent results. I have removed the necrosed os calcis with so little deformity that the loss could hardly be detected, and taken away on several occasions the upper articulating surface of the astragalus for disease, with a result which has astonished me, no external deformity remaining, and movement of the ankle being almost complete. Mr. Key in 1836 took away the whole of the outer part of the foot for injury, leaving only the os calcis, astragalus, scaphoid, inner cuneiform bone, and great toe (*vide* Fig. 630; 'Guy's Rep.,' 1836), from a boy, æt. 17, who subsequently had a useful and sound foot. More recently Mr. Birkett has done the same with a like success. Single metatarsal and tarsal bones when irreparably diseased may be removed with some confidence of a good

To sacrifice as little of foot as possible.

FIG. 630.



Foot after amputation of the four outer toes with their metatarsal bones, two external cuneiform and cuboid bones. Key's case. 'Guy's Hosp. Rep.,' 1836.

result being obtained, and any of the operations I am about to describe should only be undertaken when less severe measures are inapplicable.

Principle of the different operations.

Upon this principle the amputations of Hey and of Lisfranc were hailed with satisfaction, Hey's consisting of the disarticulation of the metatarsal bones from the tarsal, or the section with the saw of the metatarsal or tarsal bones; Lisfranc suggesting their disarticulation. Chopart's amputation, again at the medio-tarsal joints; and Syme's amputation at the ankle-joint; Pirogoff's, which is a modification of Syme's, a part of the os calcis being preserved, have all the same end in view. The subastragaloid amputation, as recorded by Malgaigne, to save the astragalus and ankle-joint, is based upon the same principle, and Hancock's amputation to save the posterior part of the os calcis with the astragalus, goes still further in the way of conservatism.

All these operations have their own value, and each is applicable to its own class of cases; where the minor measure will suffice, the major is out of all question, the principle of the least possible sacrifice of parts being the one upon which they, as all other amputations, should be based.

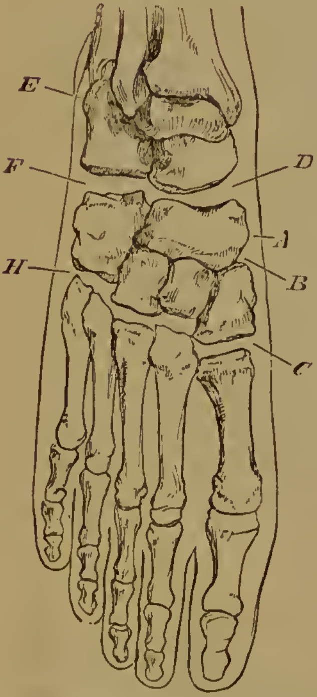
Surgical anatomy.

Before considering the different forms of amputation it will be well to consider briefly the surgical guides to the foot as expressed by its anatomy, for although in cases of disease these guides are greatly obscured, they are still of value, and in cases of injury they are always reliable. The accompanying figure will help the student.

On the *inner* side of the foot, not far from the inner malleolus, the tubercle of the scaphoid (A) is to be felt as a marked prominence; about half an inch in *front* of this will be found the articulation with the cuneiform bone (B), and one inch beyond this the joint which the Surgeon will have to open in Lisfranc's or Hey's operation (C); just above the tubercle of the scaphoid will be found the articulation with the astragalus, the line of Chopart's amputation (D).

On the *outer* side of the foot, one inch below the external malleolus, a sharply defined projection will always be felt, which is the peroneal tubercle (E), and half an inch in front of this will be found the joint which separates the os calcis from the cuboid, this joint, forming the outer circle to Chopart's amputation. Half an inch in front of this again, or one inch from the tubercle, the prominence of the fifth metatarsal bone is always to be felt (H), the line above this prominence indicating the articulation with the cuboid bone, which forms the outer boundary of the incision for Hey's or Lisfranc's operation.

Fig. 631.



Surgical guides to foot as expressed by anatomy.

All these points should be looked for in the healthy foot, and learnt so as to be readily recognised in the injured or diseased.

Hey's Amputation (Lisfranc's).

The credit of introducing this operation must be accorded to Hey, for the date of the first case he published was 1797, whereas Lisfranc's paper was only published as a suggestion in 1815.

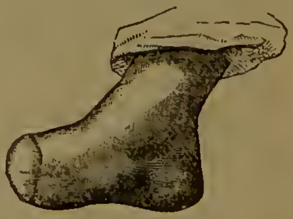
Hey's operation.

The operation consists in the removal of all the toes with the metatarsal bones by disarticulation, although it seems, from reading Hey's observations (1814) that disarticulation of the metatarsal bones was not essential, since in one of the two cases recorded, the cuboid bone was removed with some part of the astragalus, and in the second "the projecting part of the first cuneiform bone which supports the great toe was divided with a saw," and in others he stated, that he sawed through the metatarsal bones when the joints were not removed.

Description of operation.

"The operator," writes Malgaigne, in describing it, "should use a small knife with a solid strong back, and only one edge. In operating on the right foot the patient should lie on his back, and the Surgeon, facing the foot, should grasp it with his left hand, the thumb and finger respectively resting on the well-marked bony projection of the metatarsal bone of the little toe, and the base of that of the great toe placed one inch in front of the tubercle of the scaphoid. Half an inch in front of these points an incision with its convexity downwards is to be made across the dorsal aspect of the foot, dividing all the soft parts down to the bones by a second cut. The plantar flap is then to be made by two lateral incisions carried from the base of the dorsal flap along the metatarsal bones, and joined by a curved incision made on a line beyond the ball of the great toe. This flap is to be longer on the inner than on the outer side, because the internal cuneiform bone is thicker than the cuboid, and it is to include all the tissues down to the bones. Disarticulation has next to be performed, and this is best done from the dorsal region when the parts are put firmly on the stretch by depressing the toes. The operator then places the point of the knife on the outside of the joint and carrying its edge inwards he opens it as far as the third metatarsal bone. Around here he carries the knife half a line forwards, incises almost transversely, and thus reaches the second metatarsal. Here he must, above all things, remember the general precept, not to engage his knife in the joint, but to work only with its point, and to confine himself to the division of the ligaments. When this instrument has reached the second metatarsal bone, he quits this side of the articulation to attack the inner side. This is well done by inserting the knife between the shafts of the first and second metatarsal bones with its edge upwards, and with a backward and forward motion dividing the ligaments holding the second bone in place, this fact being indicated by the sudden loss of resistance which the Surgeon feels when pressing the toes downwards, and by the sudden separation of the tarsus from the metatarsus. Disarticulation is then to be completed and the plantar flap shaped by cutting for-

FIG. 632.



Stump after Hey's amputation. From Hey's work.

wards close to the bone. A long dorsal flap may be made when the plantar flap must be short."

The parts are then to be brought together by sutures, after securing the vessels by torsion or the ligature, and cutting off ragged tendons. The foot should be fixed upon a splint, with the leg semi-flexed upon its outer side, and treated on ordinary principles.

The stump left after this operation is good, and the operation one that ought to be performed when the toes and metatarsal bones alone require removal.

Chopart's amputation. Its advantages and disadvantages.

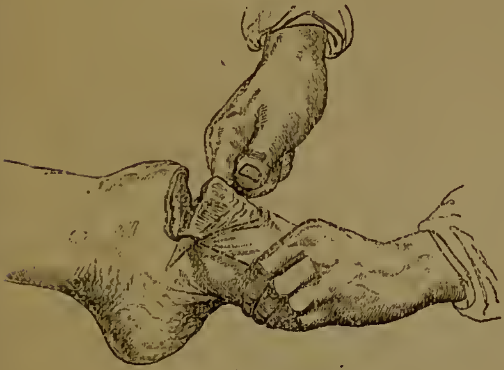
Chopart's Amputation

is an excellent and valuable operation; and should always be performed in preference to any higher measure when disease or injury is confined to the fore part of the foot. The great theoretical objection brought against it—the subsequent drawing up of the heel and the consequent pointing of the stump—has really little weight, since it can be provided against by the division of the tendo Achillis at the time of the operation, or subsequently, should the difficulty occur. In many cases of my own, the tendons have never been divided. My colleague Mr. Cock, who has performed this operation many times, thinks most highly of it, and never has had to amputate subsequently on account of the pointing of the stump. He believes that this can always be prevented or cured by the division of the tendo Achillis on the first indication of such a malformation. It was introduced into English practice in 1828, by the late Mr. James, of Exeter, and to the notice of Scotch Surgeons by Professor Syme, who subsequently, however, renounced it in favour of his own operation at the ankle-joint. He did so on account of the objection already stated, and because in such partial amputations the part of the tarsus left behind, though apparently sound at the time, may become affected with the same disease at a later period. But such an argument may be brought against all operations less than the removal of a diseased part far from the seat of mischief, and is now fairly repudiated by modern Surgeons. In fact, all excisional and conservative surgery is based upon an opposite supposition, the local nature of disease becoming daily more acknowledged and acted upon.

The operation.

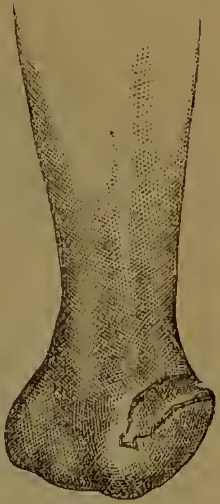
The operation may be described as the amputation of the fore part of the foot, anterior to the astragalus and os calcis, or as the medio-tarsal amputation. On the right foot it should be commenced by making a slightly convex flap from the dorsal aspect of the foot, commencing half an inch behind the prominence of the metatarsal bone of the little toe, and terminating at the tubercle of the scaphoid, the Surgeon grasping the foot, with his index finger on one point and his thumb on the other. The skin is the first part to be divided, and subsequently on the level of its retraction, all the tendons, &c., are cut through down to the bones or joints, the articulations are then opened, beginning at the scaphoid joint; the foot should be forcibly bent downwards to facilitate this part of the operation; the plantar flap is to be made by cutting forwards, and in doing this, care should be observed to keep the knife close to the bones on the sole of the foot, in order that the soft parts may be divided with as clean a cut as possible; the flap should be long and extend as far as the balls of the toes, and longer on its inner than outer aspect (Fig. 633). All ragged tendons may be cut off short, and the parts brought together. If there be any difficulty in bringing up the fore part of the stump, or any retraction of the heel, the tendo Achillis should be divided at once, but if no such difficulty is experienced such a measure is unnecessary. In dressing the stump a good opening for drainage should be left. Fig. 633A illustrates the condition of the stump a year after the operation, in which the tendo Achillis was not divided.

FIG. 633.



Chopart's amputation.

FIG. 633A.



Stump after Chopart's amputation.

On one occasion I performed this mediotarsal operation for injury, making two lateral flaps from the dorsum and sides of the foot, the integument of the sole having been destroyed. A good stump resulted.

Tripier's Amputation.

Tripier's amputation.

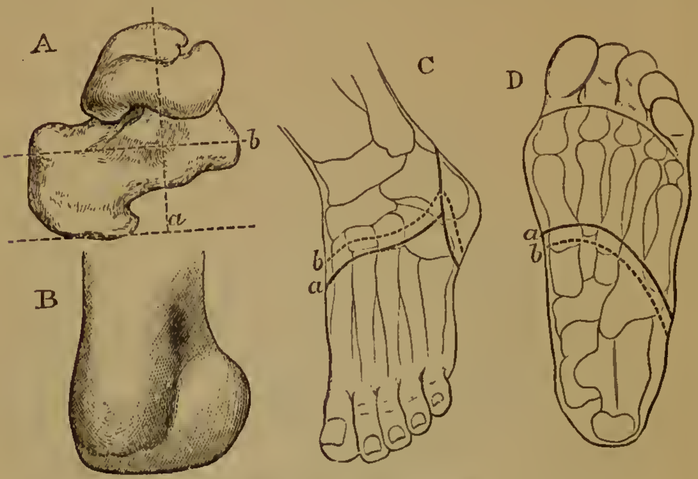
The amputation of the foot, devised by Tripier, of Lyons, as a substitute for Chopart's, claims a notice, since it professes to possess all the advantages of the Chopart and none of its disadvantages. It includes a horizontal section of the os calcis on a level with the sustentaculum tali, Fig. 634A, and gives a flat surface to stand upon, instead of the posterior part of the os calcis and the unsupported anterior extremity of the bone.

The operation is described in the 'Brit. Med. Journ.,' Feb. 26th, 1881; but I prefer the description of it given by P. Hayes, of Dublin, in the 'Dublin Journal,' Dec. 1st, 1881.

The operation.

The Surgeon's knife is caused to take the following course:—Commencing at the outer edge of the tendo Achillis, on a level with the external malleolus, Fig. 634C, a skin wound is to be made in a direction at first downwards and forwards, and afterwards forwards, so as to pass two fingers' breadths below the malleolus, and then to approach, to within a finger's breadth, the upper part of the base of the fifth metatarsal bone. From this point the incision is to be carried upwards, forwards, and inwards, so as to reach the inner margin of the tendon of the extensor hallucis proprius, just behind the first metatarsal articulation. The knife should now be made to cut downwards and forwards, so as to enter the sole of the foot a finger's breadth in front of the dorsal wound. The incision is then to be carried, with a gentle forward curve, outwards and backwards, until it can be made continuous with the first portion of the wound below the outer malleolus (Fig. 634D). The divided integument having undergone some degree of retraction, the dorsal and plantar structures are to be divided half an inch behind the superficial wound; the soft parts are then to be separated from the bones, extreme care being taken to preserve uninjured the vessels contained in the inner part of the plantar flap.

Fig. 634.



Tripier's amputation of the foot.

The Surgeon will find it convenient at this stage to disarticulate the cuboid and scaphoid from the os calcis and astragalus, just as in Chopart's amputation. Having done so, he will proceed to divide and separate the periosteum from the under surface and posterior extremity of the os calcis up to the level of the sustentaculum tali, where the bone is to be sawn through in a direction from behind and within, forwards and outwards, so as to leave a surface which will be at right angles with the axis of the tibia, when the limb is caused to assume the ordinary position for walking or standing (Fig. 634A).

All sharp bone edges and angles should now be rounded off. The posterior tibial nerve is to be exposed in the plantar flap, and divided as high as possible, with a view to prevent risk of neuroma. The vessels having been secured and drainage-tubes having been inserted, the flaps are to be brought together, and the limbs so dressed as to secure moderate flexion of the ankle-joint during the period of repair. M. Tripier attaches importance to the preservation of the periosteum covering the under surface of the os calcis when it is possible to do so. The stump yielded is a good one (Fig. 634B).

Subastragaloid amputation.

Subastragaloid Amputation

follows next in order amongst the amputations of the foot, and is the removal of as much as is taken away in Chopart's amputation, with the addition of the os calcis. It has been performed when the disease for which an operation is required involves these parts, and yet leaves the astragalus and ankle-joint sound. It seems, according to Velpeau ('Operative Surgery,' 1839), to have been first performed by M. de Liguerolles, and subsequently by Textor, although Malgaigne, in 1846, described the operation as his own without mentioning these facts.

It is made by a heel flap, as in Syme's amputation, and a dorsal flap, as in Chopart's, the foot being removed by opening the joints between the scaphoid and astragalus, and that between this latter bone and the calcis.

"The stump resulting from the subastragaloid amputation appears to me," writes Hancock, "to be perfect; it is round, and of good form; the cicatrix is firm, and well up in front, and the bottom of the stump is perfectly covered by the natural heel tissue." Nélaton says this form of amputation "has been found to surpass all amputations" ('Clin. Surg.').

I am surprised at these opinions, for in the two cases I have had of it, though the repair was good, the stumps were not to be compared with those of a Chopart, a Pirogoff, or a Syme. I shall never do it again.

Hancock's operation.

Hancock's operation must be looked upon as a modification of the subastragaloid, in the same way as Pirogoff's is a modification of Syme's, for Hancock saves the tuberosity of the os calcis and turns it up to be united to the lower surface of the astragalus, from which he takes a slice of bone. It may be adopted when, in his attempt to perform the subastragaloid operation, the Surgeon finds the lower surface of the astragalus diseased and the os calcis sound. Mr. Hancock performed it in 1864 with an excellent result. The incisions are very similar to those required in the subastragaloid, the end of the os calcis being divided in a line corresponding to the heel flap, instead of the flap being reflected. In the 'Lancet' for 1866 full particulars of Hancock's operation may be read, as described by him in a lecture at the College of Surgeons.

Syme's Operation.

Syme's operation.

This consists in the removal of the whole foot with the articular surfaces of the bones of the leg just above the malleoli; a covering for the osseous surfaces being provided from the integument of the heel, the result being, adds Lister, "a stump admirably fitted for bearing the weight of the body. At the same time the parts likely to originate carious disease are completely got rid of; so that this operation is calculated to supersede entirely that of Chopart, besides taking the place of amputation of the leg in the majority of cases formerly supposed to demand it" ('Holmes's Syst.,' vol. iii, ed. 3rd, p. 715).

This view of the operation, which was also held by its originator, emanating from one who was so closely connected with Syme, professionally and otherwise, is doubtless far too sanguine.

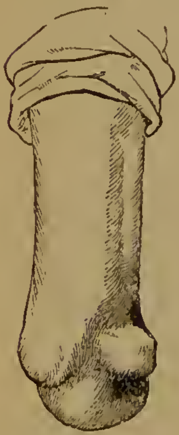
That the operation is good no Surgeon will deny when amputation of the whole foot is called for; but to say that it will supersede entirely Chopart's operation is to say what I trust never will be true, for when the bones of the ankle-joint and the joint itself are sound, no Surgeon ought to take away the whole foot if any minor measure will suffice. Where Chopart's amputation is applicable Syme's ought not to be entertained.

As an amputation of the foot, where the whole foot must be sacrificed, it is admirable; but under no other circumstances can it be recommended; that it is superior to amputation of the leg most Surgeons will admit, upon the same principle that Chopart's is superior to it on the principle of the least possible sacrifice of parts.

Statistics. It is, however, a successful operation, Hancock reporting ('Lancet,' 1866) that out of 219 cases only 17 died, or 7½ per cent.; 181 were operations for disease, and of these 11 died, or 6½ per cent.; 32 for accidents, of which 6 died, or 13 per cent. The experience of the American war speaks also in its favour, for out of 67 cases only 9 died, or 13½ per cent.

The operation. The operation is performed as follows. I give it in Syme's own words:—"The foot being held at a right angle to the leg, the point of a common straight bistoury should be introduced immediately below the fibula, at the centre of its malleolar projection, and then carried across the integuments of the sole in a straight line to the same level on the opposite side. The operator having next placed the fingers of his left hand upon the heel, and inserted the point of the thumb into the incision, pushes in the knife with its blade parallel to the bone, and cuts close to the osseous surface, at the same time pressing the flap backwards until the tuberosity is fairly turned, when, joining the two extremities of the first incision by a transverse one across the instep, he opens the joint, and carrying his knife downwards on each side of the astragalus, divides the lateral ligaments so as to complete the disarticulation. Lastly, the knife is drawn round the extremities of the tibia and fibula, so as to expose them sufficiently for being grasped in the hand and removed by the saw. After the vessels have been tied (twisted), and before the edges of the wound are stitched together, an opening should be made through the posterior part of the flap where it is thinnest, to afford a dependent drain for the matter, as there must always be too much blood retained in the cavity to permit of union by the first intention. The dressings should be of the lightest description. That the flap may, and probably will, still occasionally slough is unhappily too true; but this result is always owing to an error in the mode of performance; for as the integument, being detached from its subjacent connections, can derive nourishment only from the anastomosing of vessels, it is evident that, if scored crossways, instead of being separated by cutting parallel to the surface, the flap must lose its vitality."

Fig. 635.



Stump after Syme's amputation. From Fergusson.

Dissect heel flap from above. Instead of dissecting the heel flap from the calcis at an early period of the operation, it is a better and simpler practice to do this after the foot has been disarticulated, the Surgeon, with the foot in his hand, readily separating the heel flap from above.

In Syme's first operation, in 1842 ('Observations in Clinical Surgery,' 1861), he simply took away the malleolar projections and did not remove the articulating surface of the tibia as subsequently advised, and it is still an open question whether any advantage is gained by this extra section of bone. I have performed this operation by Syme's original method with an excellent result.

The stump following the amputation is excellent. Fig. 635, taken from Fergusson's lectures on the progress of surgery, illustrates it admirably:—"The very bit of soft material on which we naturally stand is still preserved for the future basis of this support."

Pirrie's modification.

Some Surgeons, and Pirrie amongst them, perform the operation by sawing through the tibia and fibula without disarticulating the foot. The modification is good.

Roux's method.

Roux's amputation differs from Syme's only in the flap being made from the inner and under side of the heel. I have on one occasion made a long anterior flap—the only one the condition of the parts permitted, with success.

Pirogoff's Amputation.

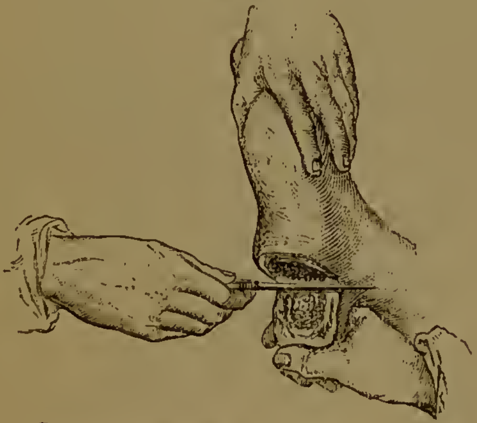
Pirogoff's amputation.

This operation is to be regarded as a modification of Syme's, and was introduced by its distinguished originator during the Crimean war. The merit he claims for it is the novel osteo-plastic principle that, a portion of one bone remaining, naturally connected with soft parts, readily unites with another, and at the same time serves to lengthen the limb and increase its utility. It differs from Syme's in leaving the tuberosity of the os calcis in the heel flap instead of dissecting it out, and bringing up its exposed cut surface to unite to the divided extremities of the tibia and fibula. I have frequently performed it, and in every instance with a good result. Busk was the first Surgeon who did it in this country, in 1857.

Advantages.

The limb is longer than after Syme's amputation, and the stump is not to be excelled (Fig. 638), since a patient can walk upon it as well as if no amputation had been performed. The incisions are the same as in Syme's, but no heel flap is dissected up. After disarticulating and dividing the lateral ligament sufficiently far for the os calcis to become visible behind the astragalus, the Surgeon has to saw through the os calcis in the line of the heel, and remove the foot, taking off, subsequently, the ends of the tibia and fibula.

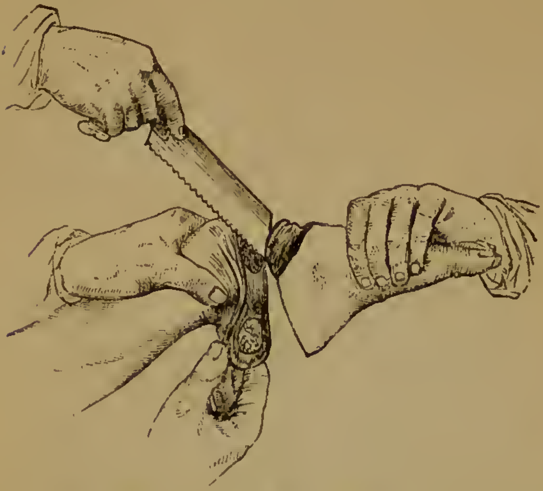
Fig. 636.



Pirogoff's amputation. Heel flap with calcis.

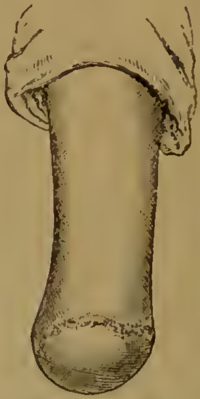
Dr. Eben Watson, after having made the heel flap, prefers, before going further, to saw off as much of the os calcis as he wants to save; but there is an objection to this practice, as I have known the incision through the bone to be made too far forwards into the astragalo-calcanean joint, and a second slice have to be removed. Dr. Watson, also, adopts Pirrie's practice of dividing the tibia and fibula without previous disarticulation of the foot (Figs. 637 and 638).

Fig. 637.



Pirogoff's amputation. Division of malleoli. Taken from T. Smith's work.

Fig. 638.



Stump after Pirogoff's amputation.

When this method is employed, the Surgeon should make a more oblique section of the os calcis from below backwards.

I regard Pirogoff's amputation as very good, and it yields an excellent stump (Fig. 638); it ought always to be preferred to Syme's when the os calcis is sound. If the bone at the time of the operation be found to be bad it must be removed, the operation resolving itself into a Syme's; but when the bone is good, it appears to be a grave error to take away what makes so good a point of support to the body.

Hancock records fifty-eight cases of this operation as performed by British Surgeons. Five only, or 9 per cent., died.

Amputation of the toes.

Amputation of the toes may be performed in the same way as amputation of the fingers already described, equal care being observed not to interfere with the plantar surface of the foot. In amputating the great or little toes the same oval flaps should be made as were recommended in amputation of the thumb and little finger (page 629). They should always be large and as much skin saved as the case will allow.

Stumps, and their Morbid Conditions.

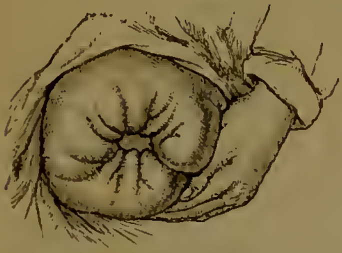
Stumps, and their morbid state.

To secure a good stump is desirable, although to obtain it by taking away more of the body than is required by the exigence of the case, no increased risk to life should be incurred. Many of the most promising stumps after an amputation often turn out badly, while the least promising end well; the result depending more probably on their subsequent dressing than on the condition of the flaps at the time, it being quite certain that bad dressing may destroy the best stumps, and good dressing improve the bad. Still, the character of the stump is much determined by the form of amputation that has been performed.

Importance of good dressing.

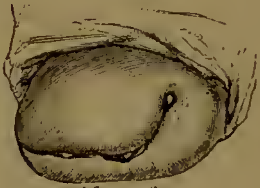
The stump after a circular amputation (Fig. 639) is not so good as that obtained after a flap (Fig. 640). The stump left after the mixed form of amputation of the leg leaves nothing to be desired (Fig. 617), and that which is met with after amputation at the knee-joint when the patella is left is unexceptionable (Fig. 641).

Fig. 639.



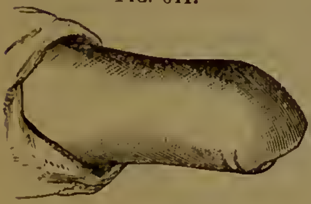
Thigh stump, after a circular amputation of thigh.

Fig. 640.



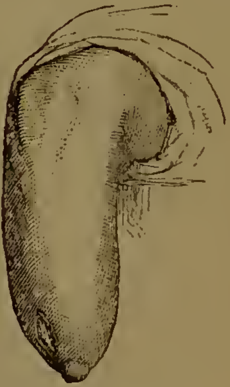
After a flap.

Fig. 641.



Stump after amputation at the knee-joint.

Fig. 642.



Conical stump.

A conical stump (Fig. 642) is always regarded as a bad one, and yet most thigh and arm (single bone) stumps after primary amputation become conical by time, the soft parts and muscles wasting, except in very fat subjects. When double bones exist, this evil is rarely seen, nor is it after amputation at the joints. Knee and elbow stumps and Pirogoff's are the best we see.

Conical stumps.

A stump that looks well after an operation, with a mass of muscle covering it, is sure to undergo a change; the muscles will degenerate, and after losing all their characteristic features, turn into fibro-cellular tissue, of which, and of fatty tissue, a good stump is

Condition of parts in stumps.

formed. The end of the bone will become rounded off, and its medullary canal filled up; the nerves of the stump also will become bulbous to a degree, but painful only when they are involved in the cutaneous cicatrix or bound down to the bone.

Growth of the shafts of bones in stumps.

At times, however, stumps grow, and become conical, and in the amputations of childhood this condition must be expected. It is best seen in the leg, as it so happens that the shafts of bones grow most where they come in contact with the larger epiphyses, and in the leg, the one entering into the knee-joint is the larger. In the case of a boy, æt. 7, whose leg I had to amputate, with some irregular skin flap, for a compound fracture, just below the knee, I have had to take away on two occasions, at intervals of three years, two pieces of bone at least an inch long, purely from the growth of the bone during childhood, and it was interesting to notice that the tibia on both occasions had grown at least twice as much as the fibula; in my second operation I never touched the fibula.

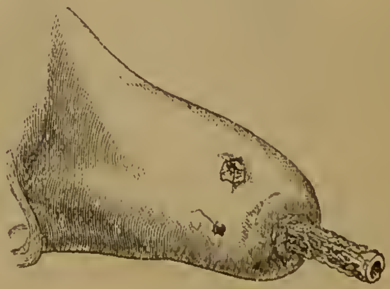
Painful stumps.

Painful stumps are most distressing; and are commonly caused by some increase in the bulbous condition of the divided nerves, the nerve being included in the cicatrix or pressed upon by the bone, and under such circumstances a cure is readily effected by the removal of the bulbous nerve. But in others, the extreme pain seems to be due to hyperæsthesia which is often called hysterical, the slightest touch of the end of the stump being sufficient to cause convulsive twitchings of the limb, and pain flying up the stump. In these cases, operative interference cannot be recommended, although nerve stretching has been advocated; the general condition of the body usually associated with this affection requires attention; tonics are always required, with local soothing anodyne applications, such as belladonna, opium, or stramonium ointments, &c.

Necrosis of bone of stump.

Necrosis of the stump is a common condition, and it is often due to too great a separation of the periosteum from the bone at the time of the operation by the forcible traction of the flaps backwards, and, at times, to a distinct endostitis of the divided bone (osteo-myelitis). In the former case, the necrosis is limited, and will probably show itself only as a ring of bone which may come away by itself or be removed. In the latter more or less of the shaft of the bone dies and subsequently exfoliates, the periosteum forming a new casing or sheath of bone to supply the dead bone's place, as in cases already described in the chapter

FIG. 643.



Necrosis of a stump.

on ostitis. The largest sequestrum I was ever called upon to remove from a stump was from the femur of a man whose lower extremity I amputated for disease of the knee-joint consecutive to acute necrosis of the tibia. The femur became inflamed by endostitis after the amputation, and ended in endosteal necrosis. The sequestrum was five inches long. I drew it out of the end of the stump some months after the amputation, and an excellent stump was left. I have had also a similar case in a child about six years old—necrosis of the stump following amputation for acute necrosis of the tibia extending into the knee-joint. The stump united after the operation by primary union, but the bone subsequently appeared in the wound as a necrosed mass, this change being attended with slight constitutional disturbance. In exceptional cases, the soft parts slip away from the bone and retract as a whole, the stump bone suddenly protruding through them for some inches (Fig. 643). In these cases the periosteum covering the bone having inflamed retracts with the soft parts, and so leaves the bone, which, deprived of its periosteum, projects from between the flaps as a dead or dying portion, the result of periosteal necrosis. Under these circumstances the stump must be reopened and the end of the bone removed high up.

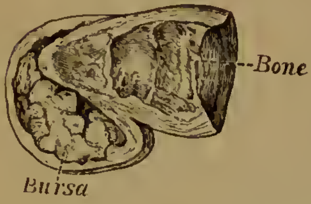
Osteo-myelitis after amputation.

Sir Joseph Fayrer tells us ('Clin. Surg.,' 1866) that in India this osteo-myelitis of the ends of stumps is a common affection, and often attended with severe constitutional symptoms such as are well known to accompany all cases of acute *endostitis* with or without amputation. He regards the affection as so serious that he advocates the re-amputation of the limb above the next joint as soon as the earliest symptoms of systemic infection appear, blood-poisoning being the chief danger of the disease. "The proper time," he writes, "for amputation in cases of diffused osteo-myelitis is as soon as possible after you have ascertained that the bone is affected; and the mode of arriving at this knowledge is simply the passage of a long probe down the medulla. Should it impinge on healthy and bleeding medulla near the surface, you may, if the constitutional symptoms permit, wait and see if nature is about to limit the suppuration and throw off the diseased bone, which is a rare result. Should it pass well up the bone its whole death is certain. In cases of incipient inflammation the medulla will be found protruding like a fungus from the central cavity, and the bone surrounding it exposed to a greater or lesser extent; at a later period the end of the medulla is found already dead, blackened, and encrusted, but within it is a putrid mass of bone, *débris*, and pus. In the former stage you can watch the progress of the case. In the latter interference is immediately necessary, and that I fear can be nothing short of amputation, either about the next joint, or perhaps in a young subject at the epiphysis. The condition of the soft parts must not deceive, the condition of the bone and the constitutional symptoms must be the guide as to the time and necessity for operations." I have made this long extract from Sir Joseph Fayrer's paper because it is through him that in recent times the subject has been brought prominently under notice, though Longmore and Holmes in this country have ably dwelt upon it, and Roux, of Toulon, made it the subject of a special report.

Fayrer's views.

In acute cases, there can be little doubt as to the wisdom of the practice suggested; but in English practice, they are not, however, of great frequency—the cases of necrosis of stumps met with being generally of a more chronic or subacute kind, of either periosteal or endosteal origin, and not requiring such active treatment.

Fig. 644.



Removed from John S—, æt. 16, who had had his arm amputated four years previously for an accident.

Aneurismal enlargement of stump arteries.

Aneurismal enlargement of the arteries of a stump has been described by Erichsen on Cadge's authority, and is an accidental association.

Cancer of stump.

Cancer may also attack a stump. In December, 1871, I removed the leg-stump of a man, æt. 58, for extensive cancerous disease of two years' standing, which attacked the cicatrix that had been formed fifty-four years (*vide* Fig. 32, p. 176). In this case amputation of both legs had been performed for gangrene of the limb when the patient was a child four years old.

Bursa over bone of stump.

When the end of the bone in a stump is not well covered and is subjected to pressure, a bursa at times forms as a protective agent. This occurred in the case from which Fig. 644 was taken. I amputated the end of the humerus with the bursa, and a good stump was left.

To Prepare and Clean Sponges.

Having shaken them to get rid of sand, and washed them to remove dirt, place them in water acidulated strongly with muriatic acid, and there let them remain until all effervescence has ceased and chalk is removed. For this purpose it may be necessary to renew the acid several times.

Let them then be well washed in plain water.

To bleach them, wash them repeatedly in a solution of binoxalate of potash ʒj, ad Oj of tepid water.

After an operation they should be washed in cold water free from blood, and then placed in a solution of carbolic acid, 1 in 80, and there left for 24 hours. They are then after another washing in pure water or carbolised water ready for use. When not at once required they should be squeezed dry, and suspended in a warm room in a porous bag to dry.

Sponges should not be placed too near a fire, since dry heat hardens them. Nor should they be washed in a solution of soda, unless they are very greasy, since alkalies dissolve spongine or horny tissue and makes it soft and incapable of absorbing moisture.

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